

THE
SOLDIER'S HEART
AND THE
EFFORT SYNDROME.

THOMAS LEWIS.

SECOND EDITION.



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THE SOLDIER'S HEART

AND THE

EFFORT SYNDROME.

BY

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BY THE SAME AUTHOR.

“Clinical Disorders of the Heart Beat.”

“Clinical Electrocardiography.”

“Diseases of the Heart.”

“Vascular Disorders of the Limbs.”

Etc.

P R E F A C E .

THIS book was published shortly before the close of the Great War of 1914 to 1918. It was based upon experience gathered first at the Military Heart Hospital, Hampstead, and later when I dealt with very large numbers of soldiers, classed as cardiac patients, while directing the clinical services of the Sobraon Military Hospital, at Colchester. It was written to incorporate what I had been teaching to officers in charge of recruiting, discharging, and pensioning boards, and to officers in charge of soldier patients. It was at Hampstead that a system of graded drills was first introduced, and later I employed these to the full both remedially and as a means of justly grading soldiers returned to hospital for

supposed affections of the heart. It was my repeated contention that the surest means of gauging physical fitness and endurance is to employ direct tests. During the war the system devised spread to many other military institutions at home and abroad and was widely accepted in the Colonial Services and in those of our Allies. The book has long since been out of print; I had hoped never to be called upon to re-edit it. But a new war has come upon us, and in these first months of it I have become increasingly aware that we are wrestling with the same old problems. Very drastic revision of the old book has been required; it has been re-written in very large part. As on the previous occasion I have not written it as a treatise on heart disease, but have collected such information, old and new, as applies particularly to the soldier.

T. L.

April, 1940.

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I.—INTRODUCTORY REMARKS.

During the last war sickness referred by medical officers of the Services to disturbances of the cardiovascular system was a chief malady. One such case was numbered for every four cases of wound. Cardiovascular disturbances followed chest complaints as the second largest group of medical ailments; it comprised in the terminology of the time, two chief groups, namely, those invalided for “disordered action of the heart” (D.A.H.), and those invalided for “valvular disease of the heart” (V.D.H.). “Irritable heart,” an earlier term than “disordered action of the heart,” dates from Da Costa and the American civil war. Da Costa believed that it led up to enlargement and failure of the heart; but time has not endorsed his view. What he described was not a disease, but a series of symptoms found in many different states. Their reference to the heart is a grave objection to each term, for it maintains among those who use it the presumption that there is a cardiac malady, and among patients each awakens serious apprehension. Because these designations were impracticable from these standpoints, and because they implied a disease, rather than a syndrome, I discarded them during the last war and introduced the more appropriate and less committal term “effort syndrome”; the term was universally adopted in this country and is still in general use. The condition to which it refers forms the chief subject matter of this book.

The magnitude of the problems presented by this condition, from the standpoint of army wastage, invalidism, and pensioning will be realised when it is known that not less than 70,000 soldiers had reported sick and were classed as cardiovascular by the summer of 1918; and 44,000 cases of "effort syndrome" became pensioners. Actually no more than one out of six of these soldiers suffered from disease of the heart, the rest were "effort syndrome" cases. The problem is the same in this war as in the last; and, if this war continues as the last did, it will not be of much less magnitude than it was in that. The belief has been expressed publicly that the health of young people in 1939 was very different from what it was in 1914, and we might be tempted on this basis to infer that the problem of "effort syndrome" will be one of much smaller dimensions than it was. Though recognising that some general improvement has taken place, I do not take this view. The condition is not peculiarly a soldier's malady; it is frequent among civilians and occurs in men and women; and I have seen no indications in hospital practice that it is substantially less prevalent than formerly. It is also very largely a latent condition, its apparent frequency in soldiers being unveiled by conditions with which the civilian does not meet. Thus, although prepared to recognise a diminished problem, I am sure it may develop again to one of notable magnitude.

The first part of the problem is how to keep cases of this malady out of the services, it is dealt with on page 82. Among cases of effort syndrome sent to hospital during the first two years of the last war 43% had symptoms on enlistment. This group was trained for an average period of 6.1 months and, at the time of computation, had spent 5.2 months in hospital. In return for these 11.3 months, they had given in the average 2 months of light duty and

2.8 months of full duty. The group gave no better service than did cases of actual heart disease, serving and invalided simultaneously.

The average length of training, of stays in hospitals, and of duty rendered (compared to the duration of symptoms).

Symptoms.	No. of patients.	Average training, including some light duty (in months).	Average duty before onset (in months).	Average duty after onset on foreign service (in months).		Average stay in hospital (in months).	
				Light.	Full.		
"Effort syndrome"	Onset before joining	242	6.1	0	2.0	2.8	5.2
	Onset on training	65	7.0	0	0.7	2.2	5.3
	Onset on active service	251	9.0	6.1	0.6	1.5	5.5
Heart disease	101	7.4	—	0.3	4.0	4.4	

A second problem is how to reduce the number of cases of "effort syndrome" developing under training. To take men in large numbers from sedentary employments, to take young men not yet fully grown, to place these in training camps, to submit them from the first to long route marches and strenuous exercise or drill, is to court a wastage of man-power. In the last war many men broke down in the first few weeks of training. Men unaccustomed to exert themselves, men still of tender years, need a cautious introduction to harder physical conditions of life. The safety of a more gradual system is now recognised; but there is room for some selection, so that the weaker men may be trained more slowly or under closer medical supervision than the rest.

A third problem concerns the treatment and sorting for future duty or discharge, of men invalided from training or duty. This is dealt with fully on page 40.

Before approaching such questions, I shall define what I mean by "effort syndrome" and describe the chief symptoms displayed by this group of patients.

II.—DEFINITION OF EFFORT SYNDROME.

When a healthy man takes exercise, and this exercise is sufficiently stressful or prolonged, he becomes aware at the time of the effort, or after it has ceased, of certain symptoms and he presents certain physical signs. The most notable of his symptoms is breathlessness, a symptom which comes during the exercise and continues with diminishing intensity for a variable period afterwards. During the exercise, consciousness of the heart beat may appear, giddiness, faintness, or fatigue may be added. After the exercise, aching of the limbs, tremulousness and exhaustion, are sometimes experienced ; at a later period, stiffness of the muscles, a feeling of lassitude and sometimes actual malaise and tremulousness are noticed. In cases of extreme effort, pain over the precordial region, at first aching but exceptionally more violent and widespread, may be felt. During the period of exercise the heart rate and blood pressure are raised ; the nostrils are dilated, the accessory muscles of respiration are brought into action to increase the tidal flow of air ; the cardiac impulse becomes more diffuse and prominent ; the sounds alter, systolic murmurs may appear at base or apex. To these physiological symptoms and signs briefly described as a group I apply the term "*physiological syndrome of effort.*" The term is used as a convenient description of the chief changes, subjective or

objective that are manifested by the human body in its reaction to exercise. Many patients, especially soldier patients, who come under observation, report sick or are regarded as sick, because they notice or present such a series of symptoms and signs. In using the term "effort syndrome" I have in mind the symptoms and signs that follow exercise in health; but I believe that I recognise the same or a very similar group of symptoms and signs in a large class of patients in ill-health. In patients of this class, if no signs of disease are anywhere discovered, they are said to suffer from the "effort syndrome." The difference in symptomatology that exists between health and this form of ill-health is largely a difference in degree; the gauge is the amount of work that, performed in a given space of time, will provoke the symptoms. Symptoms produced in normal subjects by excessive work are produced in the patients by lesser amounts; the smaller amount of work required, the more severe the malady. Naturally there is no sharp line of division; there is in a large group of patients a perfect grading from the healthy man to him who is seriously unwell. We are in the borderland between health and disease. This point of view has its value; it directs investigation towards the normal reactions of the body to exercise and to the corresponding reactions in disease; it brings us to inquire into the reserves of some of the most important bodily functions, and into the manner in which these reserves are reduced.

The term "effort syndrome" as applied to cases in this book is not equivalent to the term "irritable heart," "soldier's heart," etc., since each of these terms purports to constitute a diagnosis; it is used solely to express a group of symptoms and signs, independently of the manner in which these are brought about or the disease from which the patient may actually suffer; but its use is restricted to those

patients in whom the diagnosis is not yet accomplished. To illustrate, the clear example of early pulmonary tuberculosis may be employed. Many patients afflicted by this disease in its earliest stages suffer from the symptoms under consideration; breathlessness, palpitation, precordial pain, giddiness or faintness, easy fatigue or actual exhaustion are prominent during or after exercise. These patients have the "effort syndrome"; provisionally the term is applied to their complaint, though naturally it would be abandoned as soon as the true nature of the malady became clear. The reactions of the body to exercise are also exaggerated in those who are in process of returning to complete health, such as convalescents from acute infectious illnesses. Breathlessness, fatigue, tremulousness and palpitation, the last resulting from rapid heart action, accompany physical efforts that are accomplished without discomfort in health.

The power to continue strenuous exercise is limited in health by symptoms of oncoming distress, as everyone knows; the same symptoms occurring in people whose health is below the standard of normality are not themselves criteria of ill-health, the criterion of ill-health is the relatively small amount of work done that will elicit the symptoms. The distinction is important; for if it is not understood, the symptoms may themselves be regarded as constituting a departure from the normal. Being in large part physiological sensations, they may not be regarded as intrinsically abnormal; the abnormality lies in the circumstances in which they arise.

There is little doubt that in dealing with patients afflicted by "effort syndrome" we are dealing with a very mixed group, the chief classes of which are as follows:—

1. One of the largest groups is that of constitutional weakness, nervous, or physical, or both. In this group are

many who show incomplete or imperfect development. To it belong many undersized men, many with flat or elongated chests ; to the same group belong many with family histories tainted by insanity or epilepsy, and those who in childhood were nervous weaklings, bed-wetters, somnambulists, or possessed of night terrors.

2. Another large group comprises those who may be regarded as played out by exposure, hard continuous work, disturbed sleep, and by the constant strain and jar to body and nervous system, which work in the front line brings.

3. A third chief group comprises patients who may be regarded as exhibiting delayed convalescence from acute illnesses such as rheumatic fever, pneumonia, pleurisy, dysentery, trench fever, severe influenza or tonsillitis.

4. A not inconsiderable group is that comprising actual though unrecognised infection, including incipient tuberculosis, local pus infections, infections of the intestinal tract.

In each and all of these groups, breathlessness, fatigue, and the remaining symptoms are induced by abnormally small effort. In all groups the subjective symptoms at present appear to be similar or the same.

The picture drawn is in many ways a picture without a central motive to fix the attention ; it is perhaps better that it should be so ; for if the "effort syndrome" is regarded as due to a specific form of disease, the right attitude towards the individual patient is at once lost. That attitude is often one of deferred judgment, an attitude of inquiry. Each case should come to the medical officer on its own merits, and the very use of a term that describes symptoms rather than disease goes far to introduce and perpetuate this attitude of inquiry.

When the young manhood of a nation is placed under arms, its whole habit of life, its housing, dietary, and clothing,

its times of rest and of work, the nature of its employment, changed, when with little or no preparation it is submitted by war to enforced and strenuous training, when subsequently it is sent to meet wholly unusual and unnatural conditions, which stretch each muscle fibre and vibrate each nerve cell and nerve fibre of the body to the full, then the manhood is submitted to a most drastic test. Who then can affect surprise if many men fail when so tested? The test in its entirety selects, it selects the weaklings in the general sense and marks them down. It grasps those who lack physical strength or nervous stability; it grasps those seemingly in full health and yet the subjects of incipient disease. Many it breaks at once, some it breaks only in the end. Healthy men break when the trial is too long continued; there is a limit to the endurance of each and all.

III.—ETIOLOGY OF EFFORT SYNDROME, ETC.

What we know of the factors producing "effort syndrome" may be introduced by considering the work of the men in civil life ; for this will lead up to other and very relevant factors of causation.

Occupation before enlistment.

Of soldiers invalided for "effort syndrome" in the last war no less than 57 per cent. were recruited from sedentary or light occupations. Men in sedentary occupations include clerks, shop assistants, attendants, printers, teachers, students, etc. ; men in light occupations include waiters, stewards, painters, etc. Clerks alone numbered 15 per cent. of the whole. From moderately heavy employments (carpenters, fitters, carmen, electricians, etc.) 20 per cent. had been recruited ; and from heavy employments, such as professional soldiers, general and farm labourers, miners, smiths, etc., 23 per cent. had been recruited. Thus, the incidence was heavy among men engaged in indoor and sedentary work before recruitment. The fact is accounted for in one of several ways. A large percentage of the patients suffered from the condition for years before joining the Army ; of these, many had been forced to adopt sedentary occupations and had given up heavier work earlier in life

because of unfitness for it. The "effort syndrome" is common among civilians, often precluding heavy work; usually it does not preclude sedentary work or light work; affected civilians, therefore, tend to drift into these employments, and once they are so employed they are able to continue with slight discomfort or entirely free from symptoms. Thus the men frequently related that they felt well once sedentary work was adopted, though unable to engage in outdoor games or exercises. But a greater number entered sedentary occupations for other reasons. Of these, some became aware that they were unfit for strenuous exercise at a later date, others had never so tested themselves, and the

Occupation before enlistment, expressed in percentage figures.

	"Effort syndrome" (543 soldiers)	Heart disease (92 soldiers)	Gun-shot wounds. (100 soldiers)
Sedentary or light	57*	42	31
Moderate	20	22	40
Heavy	23	36	29

* Made up of clerks (15%), salesmen and other sedentary workers (12%), printers, painters and other light workers (30%).

symptoms of these often dated from the earliest days of training. It is probable that many of those recruited from sedentary occupations were affected before joining, although previously symptoms had not manifested themselves. Sedentary work probably predisposes to the affection. Training may rid men of a predisposition or of early symptoms; lack of exercise reduces the reserve, training increases it.

Some patients related that symptoms previously experienced disappeared early in training to return later on active service; but the number of men who enjoyed a similar early experience and fought without recurrence of symptoms is unknown.

The accompanying table shows the previous occupations of soldiers invalided for disease of the heart to be not dissimilar. The high percentage of those formerly employed in light work is to be ascribed, as it is in part in the "effort syndrome" group, to unfitness for heavier work before the men became soldiers.

The constitutional factor, physical and nervous.

It has been said that many of the cases of "effort syndrome" drawn from sedentary occupations were in these occupations because unsuited to heavier work. Of this class many showed defective physical development. In some the chest was long and narrow, or flattened and kyphotic. In others there was general under-development, short stature and meagre build. Among them was an unusual number presenting a respiratory vital capacity below the normal standard. It is often impossible to separate the defects dating from birth from those belonging to the period of growth, and attributable to faulty hygiene in childhood; but the defects are certainly derived from both hereditary and acquired sources.

Similar remarks may be made of the nervous system. Nervous manifestation in the men as a group are common, though again it is often difficult to distinguish between those resulting from hereditary defect and those from acquired weakness. The psychological characteristics of the patients as a group are not those of the average soldier; many of the

men are of highly-strung nervous temperament, an unusual number is sensitive or querulous, others are apathetic or depressed. An unusually large proportion eschews the use of alcohol for conscientious reasons. Unreasonable phobias are not so common as minor psychoses, such as fear of the dark, and thoughts which while fanciful are recognised as such by the men who experience them. Defects of memory, inability to concentrate, mental confusion at the attempt to concentrate are very common. The sexual tendencies and activities are not in the average normal. Exposure to venereal disease is relatively rare; spermatozoa in large numbers are found in the morning urines in 15 per cent. of the patients. Enquiries as to the condition in childhood frequently elicit a history of nervousness, frights, somnambulism, or nocturnal enuresis. A small proportion is subject to terrifying nightmares; battle dreams predominate among these. Breathlessness or fainting attacks of hysterical form occur.

In my view such nervous symptoms are not to be regarded as parts of the "effort syndrome." They are certainly not essential to it, for most cases are without them; they are added to the syndrome and are of sufficient frequency to leaven the whole group. A matter more relevant to the present discussion is to know if the symptoms properly belonging to the "effort syndrome," namely, persistently increased heart rate and blood pressure, and exaggerated breathlessness on effort, can arise directly out of anxiety states; it seems probable that they can, and that abnormal anxiety must be regarded as a real and important contributing cause in given patients

Understanding of the relation between nervous states and "effort syndrome" affects successful treatment and deserves further and very careful study.

Enough has been said in this general and brief survey of constitutional weaknesses to indicate the kind of material upon which determining factors come to play.

Strains of training and of service.

Dealing as we are with a mixed group of men, many of whom have been deficient from childhood in physical strength, in respiratory reserve, or in mental stability or reserves, it is not surprising to find that they wear badly under circumstances of training and of service.

When men were taken in large numbers from sedentary employment in 1914 to 1918, young men, some not yet fully grown, some of them weaklings, and submitted from the first to long marches and strenuous exercise and drills, many of them broke in the first few days or weeks. Men unaccustomed to exert themselves need a more cautious introduction to hard physical conditions. The need of a more graded system has since been recognised.

But the majority breaking down does not break on training, but on duty, and especially on duty overseas. The hard physical labour that is endured in trenches, exposure to moisture and cold, irregular feeding, insufficient and frequently broken sleep, the constant wracking of nerves by violent noises, by recurrent fear, and continuing anxieties, infection by epidemic or endemic disease, combine to bring inevitable and continuous fatigue, loss of resistance, impairment of health, and ultimate break down on physical or mental side. Especially will this end result be reached in those originally presenting constitutional weakness. A gradual onset of symptoms on duty, and not a sudden development from some specific incident, is the rule.

Infection.

A frequent etiological factor in the clinical histories of soldiers complaining of the "effort syndrome" is infection of one kind or another.

Ascribed cause of onset. (Year 1914-1915.)

Symptoms date from	"Effort syndrome"	Heart disease
Gradual onset	314 (56%)	52 (51%)
Rheumatic fever or chorea ...	68 (12%)	25 (25%)
P.U.O. or influenza	28 (5%)	1 (1%)
Dysentery	17 (3%)	1 (1%)
Pleurisy and bronchitis ...	15 (3%)	0 (0%)
Pneumonia	10 (2%)	2 (2%)
Diarrhoea	10 (2%)	0 (0%)
Enteric fever	6 (1%)	1 (1%)
Other infectious diseases ...	27 (5%)	7 (7%)
Wounds and accidents ...	19 (3%)	6 (6%)
Gassing	14 (2%)	2 (2%)
"Shell-shock"	13 (2%)	2 (2%)
Under bombardment ...	9 (2%)	0 (0%)
Sudden strain	5 (1%)	0 (0%)
Frost-bite and inoculation ...	3 (1%)	2 (2%)
Total	558	101

Thus among 558 patients, the symptoms dated from an infectious disease in no less than 181, or 33 per cent. Rheumatic fever, standing actually at 12 per cent., easily occupied the first place, pyrexia of unknown origin or influenza occupied the second place and dysentery came third. But the full 33 per cent. is by no means exhaustive; thus, among the 377 patients remaining, a history of rheumatic fever occurred either some time before the onset, but not

directly connected with it, or more rarely months or years after the onset of symptoms, in 57 cases ; there was a similar history of repeated joint pains or chorea in 8. Thus 65 of these patients belonged to the rheumatic class, although the precise significance of rheumatism in relation to the malady was in many uncertain. Of the remaining 311 patients, a further considerable proportion had suffered prior to the onset of symptoms from pneumonia, pleurisy, bronchitis, dysentery and other infectious diseases ; a history of repeated tonsillitis was frequent. In at least 50 to 60 per cent. infectious diseases may be held to have played a chief part in promoting the syndrome. In a few cases a chronic infection appeared to be the sole and continuously underlying

Prevalence of infectious diseases, etc. (Year 1914-1915.)

	" Effort syndrome " (558 soldiers)	Heart disease (101 soldiers)	Gun-shot wounds (100 soldiers)
No past illness or accident	99 (18%)	11 (11%)	82 (82%)
Rheumatic fever or chorea	127 (23%)	62 (61%)	4 (4%)
P.U.O. or influenza ...	69 (12%)	6 (6%)	0 (0%)
Enteric or enteritis ...	43 (8%)	1 (1%)	4 (4%)
Wounds or accidents ...	37 (7%)	10 (10%)	—
Dysentery	33 (6%)	3 (3%)	2 (2%)
Pneumonia	34 (6%)	10 (10%)	3 (3%)
Scarlet fever	26 (5%)	1 (1%)	1 (1%)
" Shell-shock "	22 (4%)	5 (5%)	0 (0%)
Gassing	17 (3%)	2 (2%)	0 (0%)
Bronchitis	19 (3%)	0 (0%)	4 (4%)
Tonsillitis	45 (8%)	6 (6%)	0 (0%)
Malaria	15 (3%)	0 (0%)	6 (6%)
Venereal disease	13 (2%)	4 (4%)	5 (5%)
Pleurisy	16 (3%)	1 (1%)	3 (3%)
Trench fever	5 (1%)	0 (0%)	0 (0%)
Trench feet... ..	9 (2%)	3 (3%)	0 (0%)
Other illnesses	87 (16%)	5 (5%)	0 (0%)

The analysis has been carried out in each group upon similar lines. Any infection that has kept the subject of it more than two or three days in bed is entered in the table. Quinsy, and repeated or severe tonsillitis are included ; uncomplicated exanthema occurring before the age of 10 years are excluded. In the table, incidents such as " shell-shock," gassing and wounds are also included. If a patient has suffered from the same malady or accident on two occasions, this illness is included once only in the construction of the table, so that its statement may be simplified.

cause ; for after the successful treatment of dysentery or chronic appendicitis the symptoms vanished.

It is of interest to compare the incidence of infectious disease and the frequency of serious illness among "effort syndrome" cases, with that in heart and gun-shot wound cases. Among 558 patients of the "effort syndrome" group, not much less than 80 per cent. had suffered from an illness that might be regarded as serious. In the 100 men suffering from gun-shot wounds, men of similar ages and invalided after equal or longer periods of service, the incidence was but 18 per cent..

The history of the onset of symptoms at the time of an infectious disease was about as frequent in sufferers from the "effort syndrome" as in soldiers with heart disease (33 per cent. and 37 per cent., respectively); the incidence of illnesses generally was also not dissimilar in these two groups, approximately 80 per cent. of the histories showed it in both groups. Thus there is a close similarity between the two groups in respect of their past liability to infections; the chief difference is found in the types of infection. In the "effort syndrome" group, the total incidence of rheumatic fever and chorea was 23 per cent., in the heart disease group 61 per cent.; in men invalided for gun-shot wounds, the controls, 4 per cent. The onset of symptoms dated from rheumatic fever in 12 per cent. of the "effort syndrome" group, and in 25 per cent. of the heart disease group. The infectious illnesses, to which cases of the former class had been more prone than heart cases, were pyrexia of unknown origin and enteric fever.

The figure 61 per cent. for the incidence of rheumatic fever (or chorea) in heart disease in soldiers, although high as compared to the figure for the civilian populace, is the proper figure to accept in comparing the influence of rheumatic fever in the two groups; for the comparison is between

classes of men of similar age and environment. In soldiers who have already acquired the "effort syndrome," serious infections almost always, and mild infections often, increase the severity of symptoms. It is impossible fully to present the incidence of infection as an aggravating cause, but it may be illustrated by the statement that of the large group of 314 patients in whom the immediate cause of onset remains uncertain, at least 50 were first invalided to hospital for infectious diseases that were found, during convalescence from the intercurrent illness, to have aggravated the symptoms; an even larger number gave histories of similar infections aggravating the symptoms at more remote periods. In the military heart hospital an attack of tonsillitis, influenza, or similar infection is followed by a conspicuous general set-back of exercise tolerance and by an exaggeration of symptoms and signs.

The relation of infections to cases of heart disease may here be emphasized in comparison. Mitral stenosis, and aortic disease in the young, are usually due to inflammatory processes of infective origin. The close relation of events in the subsequent history to infectious processes is also widely recognised now. Nothing jeopardises the condition of heart patients more than infection, be the infection rheumatic fever or an infection expressed as tonsillitis, influenza or bronchitis. In civilians as in soldiers, careful questioning and observation show this factor to be of much greater consequence than strain. Obvious infections are the frequent predecessors of exaggerated symptoms; they are frequently responsible for failure with congestion. Infection has more to do with heart failure than has strain or a mechanical defect in the heart itself, at all stages of the disease, in its initiation, in its development, and in its progress to immediate circulatory embarrassment and death.

Heart strain.

It was long thought that the healthy heart can suffer strain as an immediate result of strenuous or prolonged bodily exercise. The idea was part of a general conception, formerly held, that heart failure results mainly from the heart being overburdened by work.

It is to be remembered that the strain of weight lifting, or of other strenuous act, never falls directly upon the heart, it falls on muscle, tendon, and bone, and is only placed indirectly upon the heart by rise of blood pressure, of pulse rate, and of output. The muscular effort may be abrupt, the call upon the heart comes more gradually, through normal physiological channels and under the direction of natural controls. The circulatory organs are built to withstand strains, which they themselves largely create; and the reserve capacity of the heart for work is many times greater than the capacity adequate for the body at rest. The hypothesis of heart strain was built on an unsound foundation. Some have believed that the fibres of the heart can be injured directly under strain; others that the heart dilates injuriously.

It has been said that athletes strain their hearts. But it would appear that those who row in boat races are not short lived, neither do they die of heart affections more frequently than do other men. The condition called "rower's heart" or "athlete's heart" is identical with what is here called "effort syndrome."

The hypothesis of heart strain has been applied with emphasis to soldiers. The tight tunic, the belt, the shoulder strap, the pack, and long marches have in turn been called to account. The belief in strain was held more easily in the days when soldiers walked scores or hundreds of miles in the absence of quicker modes of transit. The physical strain

imposed upon troops in war-time is less than it used to be, yet "effort syndrome" is as prevalent as it was. It may be present among troops in training as often as among those on front line duty; it develops in many civilians to whom strenuous exercise is and always has been unknown. Very few soldiers in the last war dated the first onset of symptoms to an unusual strain. Such a history was obtained in only 5 out of 558 cases. If a soldier lifts a heavy shell and is from that moment breathless the symptom is not to be ascribed to the act. He has lifted these shells many times before without trouble. If the respiratory reserve of a soldier is declining gradually, or has declined, it is not surprising that his first distress should come at a moment of exertion; that is the occasion on which his reserve is put to the test and found wanting. The only form of history in which strain can be admitted as a possible primary cause would be one in which the onset of symptoms occurs in a perfectly healthy man at a moment of unusual effort, the symptoms persisting from that time even though he is afterwards engaged in lighter work. Such a history is extremely rare. The chief part which effort plays is clear, it calls upon a waning reserve, aggravating pre-existing breathlessness, or bringing a dormant defect to light. In rowers, as in soldiers, the idea of heart strain has been coupled up with dilatation of the heart; and has found support in the diffuse impulse, which has been regarded wrongly as a sign of dilatation (see page 64). A very large number of X-ray observations has been made on the influence of exercise upon the size of the heart both in normal subjects and in athletes. It is known that at the end of exercise the heart is no larger, or it is smaller, than normal, even in men exercised to exhaustion. During exercise it is now generally conceded that the heart may dilate a little; but such dilata-

tion is entirely physiological, a response to the increased flow of blood to the heart and one which is beneficial and not injurious. Injurious dilatation is safeguarded by the fibrous pericardium beyond the limited capacity of which the heart cannot dilate. The heart may be acutely distended, till it reaches the pericardium, by inspiring strongly with the glottis closed; this is an experiment that may be performed time and again with impunity by healthy men. In paroxysmal tachycardia the heart sometimes dilates greatly; when the paroxysm ceases, the organ shrinks to its original size, and the subject of the paroxysm is none the worse for it. Here is an instance in which a pulse rate of perhaps 200 per minute is maintained night and day for a week or more; the heart dilates and the patient becomes cyanotic and his liver swells. Yet, soon after the paroxysm ends, the capacity of the man for work is precisely what it was before the paroxysm began. In effort syndrome in soldiers the heart is not dilated, even in those presenting diffuse impulses, X-rays show the heart to be in the average smaller than normal. Of the thousands of patients to whom we gave graded exercises during the last war, a few score fainted while at work; not a single one of these when examined showed signs of dilatation either at the time or afterwards; not one of them was the worse for his experience.

Neither in civilian nor in military practice have I seen a patient in whom the evidence for heart strain as a primary cause of breathlessness could be regarded as at all convincing; yet many patients purporting to be instances of such strain have been shown to me. In cases of so-called acute dilatation of the heart that I have been called to see and in whom dilatation was present, the basal condition has almost always been an unrecognised paroxysm of tachycardia.

If strain of the heart exists it is no more than a curiosity.

Influence of tobacco.

The consumption of tobacco by "effort syndrome" cases as compared with that by wounded soldiers is small; the consumption in heart disease is smaller still.

Tobacco consumption.

	"Effort syndrome" (461 soldiers)	Heart disease (87 soldiers)	Gun-shot wounds (100 soldiers)
Non-smokers, or very occasional	6%	13%	2%
About 2 cigarettes daily, or 1 oz. a week ...	20%	22%	3%
About 5 cigarettes daily ...	42%	40%	23%
About 10 cigarettes daily, or 3 ozs. a week ...	27%	22%	49%
About 20 cigarettes daily	4%	1%	21%
Over 25 cigarettes daily, or about 10 ozs. weekly	1%	2%	2%

Alcohol consumption.

	"Effort syndrome" (454 soldiers)	Heart disease (83 soldiers)	Gun-shot wounds (101 soldiers)
Teetotallers... ..	53%	43%	33%
Occasional drinks ...	12%	17%	20%
One pint of beer or less daily	15%	22%	25%
Two or three pints daily...	18%	11%	14%
Over three pints daily ...	2%	7%	8%

That tobacco is a chief cause of the "effort syndrome" is disproved by these observations and by the knowledge that the condition is frequent in Sikh soldiers (Macgregor), to whom smoking is forbidden. But smoking aggravates the symptoms as many of the patients admit. The reaction of the pulse rate to exercise is found to be increased by smoking

(Parkinson). The heaviest smokers are those with the best exercise tolerance, for they are relatively undisturbed by smoking.

The small consumption of tobacco among cases of heart disease is similarly ascribed to its adverse effects on symptoms.

Consumption of alcohol.

Among "effort syndrome" cases 53 per cent. were found to be teetotallers, compared to 33 per cent. in cases of gun-shot wound. The consumption of alcohol among the men in the first group was small; instances of men returning to hospital the worse for drink were rare. The severe cases drank less alcohol than the mild cases. The reasons assigned for abstention were usually conscientious, some had no inclination; in a few alcohol aggravated the symptoms.

Among cases of heart disease the consumption of alcohol is intermediate between the "effort syndrome" and gun-shot wound groups.

Hyperthyroidism.

During the last war the idea that "effort syndrome" might be due to disturbed thyroid activity was much discussed and investigated. Hyperthyroidism was invoked to explain tachycardia, tremor, and loss of flesh. Now these are common enough in many forms of ill-health. Fully displayed Graves' disease was rarely seen during the war, and did not develop in an appreciable number of effort syndrome cases, followed for years after the armistice. Minor enlargements of the gland were not infrequent, but no more so than in young soldiers generally. The heart rates prevailing, the exercise tolerance, and subsequent fitness for duty were the same in those with and those without an easily

palpable thyroid. Reported improvements as a result of exposure of the thyroid to X-rays were unconvincing. A strong point against hyperthyroidism is the prevalence of cold hands among cases of "effort syndrome." A stronger point is that, when these patients are reduced to absolute rest, pulse rate and basal metabolism are normal.

Gas poisoning.

In the last war about 30 per cent. of gassed cases complained of symptoms subsequently ; but these appear to have been transient in most cases. Gas poisoning was ascribed as the cause of symptoms in only 3 per cent. of cases of "effort syndrome" invalided home. Drift gas was more blamed than mustard gas.

Explosion.

A small percentage of "effort syndrome" cases in the last war attributed their symptoms to explosion of shell or mine. Considering the number of soldiers exposed to explosion, the number attributing their symptoms to it was remarkably small. As but a few out of many similarly exposed afterwards suffered, it is to be concluded that in these there may have been a predisposition. Immediately after the event a history of preceding symptoms is rarely to be obtained from the men ; the explosion is too prominently in their minds ; but at a later date such a history may often be elicited. When, on account of minor symptoms, men are hard put to it to fulfil their duties, when there is a struggle between the sense of duty and consciousness of unfitness, the consequences of being blown up are not difficult to understand ; it is clearly but an aggravating cause almost as

often as it is suspected to be the provoking cause. It is probable that it is never more than an aggravating cause.

It is curious and interesting to note that soldiers suffering from heart disease attributed their symptoms to explosion as often as did "effort syndrome" cases; and explosion was also as frequent in aggravating the symptoms in the two groups.

IV.—SYMPTOMS IN EFFORT SYNDROME.

Breathlessness.

The breathlessness of the effort syndrome is essentially a response to effort or excitement. It is absent when the patient is at absolute rest, but appears while he is up and about and especially when he exercises. The breathing may be rapid and shallow, or it may be of normal or somewhat increased rate and deepened. When a normal subject walks smartly up a flight of 40 steps, the respiratory rate is raised no more than a few cycles per minute. In patients who present the "effort syndrome" the reaction is exaggerated, and the respiratory rate may rise to 40, 50, 60 or even 70 per minute; or with a slight rise of rate it is deepened by such a test. More strenuous exercise brings severe distress, panting with mouth open and nostrils moving.

The causes of this form of breathlessness are still understood imperfectly.

In a few patients the vital capacity of the lungs is sufficiently reduced to account for breathlessness. The full expansion of the lungs is not used by men resting and in health; there is a large reserve. In some few men, poorly built and with flat or narrow chests, this reserve is small, and being small is soon exhausted as inspiration deepens. Nevertheless, the vital capacity in the "effort syndrome" group is in the average only a little below normal and the

chest measurements are only a little below those of peace time recruits of the same weight and height.

In some patients the breathlessness is attributable to the nervous system or is aggravated by the condition of this system. To this last class belong patients who become breathless during medical examination or in response to sharp orders on drill, or to loud noises.

Genuine breathlessness is difficult to simulate; it is accompanied by tightening of the accessory muscles of respiration, the face expresses anxiety, and the speech of the patient is disturbed by inspiratory movements. The breath cannot be held long, and if held the distress is afterwards exaggerated. In "effort syndrome" cases of a moderately severe type that are up and about the breath cannot be held as a rule more than 10 seconds.

Breathlessness of the effort syndrome is to be distinguished from hysterical and from cardiac breathlessness.

Hysterical breathlessness.—The cases are rare. The breathlessness is present even at complete rest, but is confined to waking hours. It is rhythmic and shallow, and may be as fast as 50 or 60 a minute. I have seen one example in which the rate was 200 per minute.

Cardiac breathlessness.—In young men breathlessness due to cardiac failure is nearly always accompanied by evident signs of disease of valve, or of cardiac enlargement, either of which will in itself mark the man as unfit. Cardiac breathlessness cannot be diagnosed in the young without such signs. This breathlessness is also provoked by exercise, less commonly by excitement, it is deep, not shallow, and rarely very rapid. There is a useful relation between it and signs of congestive failure. When breathlessness of cardiac origin occurs at rest or on walking slowly on the flat, the veins will be found to show distinct signs of engorgement.

If more strenuous exercise is required to induce breathlessness, signs of venous congestion are not to be expected.

In patients who are the subjects of early mitral stenosis or aortic disease, breathlessness is often conspicuous by its absence. In many of these patients exercise is well tolerated ; in many who experience breathlessness the symptom is not of cardiac origin, but owes its existence to the same causes as does the breathlessness of the "effort syndrome" group of cases.

In middle aged or elderly men, and especially in essential hypertension, and in syphilitic aortitis, breathlessness may occur in the resting subject and in the absence of venous congestion. Frequently it is worse at night, waking the patient with a feeling of suffocation. Gallop rhythm and Cheyne Stokes' breathing are often associated.

In men of 50 years and more when breathlessness occurs, but no signs are to be found, it is safest to regard the breathlessness as cardiac in origin.

Fatigue and exhaustion.

In "effort syndrome" fatigue varies in degree and, when it can be gauged, is an excellent index of the severity of the affection. The mildest cases suffer such fatigue on exercise as would a healthy man who is out of training, in the severer cases it is experienced after very brief and simple exercises. Lassitude is especially prominent in the early morning and late afternoon. More rarely, fatigue on exercise proceeds to exhaustion. Fatigue and the early signs of exhaustion appear objectively in the expression of the face and in the droop of the body ; a material feeling of weakness is usually accompanied by uncontrollable tremor of the hands, or shakiness of the legs. The symptoms are those which are found in healthy subjects submitted to

strenuous exercise. That they have the same origin is rendered probable by their association with a general feeling of malaise and in some patients with a rapidly developed and severe "stiffness" of the muscles.

Pain.

Under the complaint pain, "effort syndrome" cases often include sensations of discomfort such as a feeling of tightness in the chest or even the sensations to which a rapidly beating heart, acting against the chest wall, gives rise. Frequently the complaint is of pain in some part of the body well removed from the heart, for example, in the shins (when there has been a history of trench fever), in the back, in the shoulders or abdomen. By most patients it is referred to the left side of the chest. In some of these the pain occurs over the lower ribs on the left side, but more frequently it is referred definitely to the precordium. Pains of gastric origin are not infrequent. Of precordial pains, an ache or a feeling of soreness are the commonest; stabs of pain, which may synchronise with the heart beats, are sometimes described; very rarely also the pain is described as radiating into the neck, into the left arm, or into the fingers. In almost all patients who experience these precordial pains the symptom is increased by exercise; in most cases of genuine discomfort it is only present on or immediately after exercise.

Usually there is a foundation for the complaint; very often the degree of discomfort is exaggerated. Complaint of pain should rarely be allowed to weigh in estimating the fitness of these men or in assessing their disabilities. Inexperienced medical officers may produce an epidemic of pain complaints in their wards by paying injudicious heed to such. Very few of the patients have such pain that they

will willingly lie in bed to avoid it ; yet, if encouraged to do so, patients will come complaining to the examination room in numbers. Hyperalgesia of the skin or muscles of the chest is of some value. It is to be found after exercise in a goodly proportion of the men. It may be present over an area of small extent, usually the region of the maximal impulse, or scattered over several small precordial areas. Most frequently it is discovered over a wide area of the chest wall. The pectoral muscles are often tender when pinched, and sometimes the trapezii and sternomastoids are also implicated. In rare cases the skin of the inner side of the left arm is tender. But it is not unusual to encounter patients in whom the musculature of the whole chest, abdomen and even the limbs is tender when squeezed. Precordial tenderness is valuable in corroborating a complaint of pain ; but its presence must be elicited so far as possible without acquainting the patient that it is sought (see remarks on page 48). It is discovered more frequently in patients in whom there is a past history of rheumatic fever than in those in whom there is none, and the patients who present it are relatively intolerant of exercise.

In those rare cases in which the pain radiates to the left arm, it is necessary to differentiate the pain from that of grave angina pectoris (see page 80).

Palpitation.

Palpitation or consciousness of the heart beat in the "effort syndrome" is a frequent complaint. In some it is produced by extrasystoles and then consists of an occasional feeling of discomfort in chest or throat, or as a detached thump of the heart ; it is experienced for the most part during rest after exercise, and disappears entirely during actual exercise. In the great majority it is the result of rapid

and energetic heart action, the normal rhythm being undisturbed. This form of palpitation is felt specially during exercise and under emotional excitement. It has no significance from a prognostic standpoint other than the significance of associated high pulse rate.

Other very occasional causes of palpitation are due to paroxysmal tachycardia (page 76) or to auricular fibrillation (page 75).

Fainting.

Among cases of the "effort syndrome," fainting is not infrequent. It may be the first symptom that the patient can remember; it may have occurred on a single occasion or may have been repeated at intervals of weeks or months. Usually the provocative cause is unknown; the man collapses or falls heavily while standing still or while walking quietly and unalarmed. In other instances sudden alarm, as by machine gun or shell fire or slighter stimuli, has been responsible. In a few cases it has occurred during or immediately after an inoculation.

A young soldier, who presented the usual concomitant symptoms but no signs of structural disease, was sitting at rest in a chair; a few c.c. of blood had just been withdrawn from a vein in the arm and the needle had been removed. There was no complaint of local pain, and he subsequently affirmed that the withdrawal of blood in no way distressed him. He began to feel nauseated; he became dizzy; pallor was noticed; his head fell forward to his knees. He was at once placed in a long easy chair and further observed. By this time pallor was intense and he was restless. The pulse was imperceptible, the heart sounds were distant, the rate of beating being 50 per minute; the action was for the most part regular. From time to time there were retching

movements, the pupils were little, if at all, dilated ; he was limp, mentally confused or actually unconscious for several minutes. A heavy sweat broke out over the forehead and spread over the chest and body ; the pallor remained extreme ; respiration was slow and sighing. The pulse was imperceptible for several minutes ; as it returned the systolic blood pressure was registered at 60 mm. Hg. A little later the pressure fell to 55 and then to 50, the pulse varying in rate between 50 and 60. Five minutes after the onset some recovery was noted, the pulse had risen to 64 and the blood pressure to 80. Nine minutes after the onset he was able to respond to questions (pulse rate 88, blood pressure 105). The blood pressure gradually rose to 110 mm. half an hour after the onset, and the man was able to leave the chair and walk supported across the room. The average blood pressure of this man in ordinary circumstances was 118, the pulse rate 80 to 90. He was shaky and exhausted for 36 hours subsequently. It was his second attack, the first having been experienced while saluting on guard duty.

This example is one of similar fainting attacks witnessed in a number of patients ; in some they have followed the drawing of samples of blood, in some they have come without warning in patients standing and waiting routine examination. The simultaneous falls of pulse rate and blood pressure stamp the attacks as the common fainting attack which is vasovagal in origin, a view fully confirmed by the occurrence of simultaneous gastric disturbances and by the observation that atropine at once raises the pulse rate.

Such attacks, when witnessed, can scarcely be mistaken for epilepsy. If the medical officer has to rely upon the patient's statements, then the onset with gastro-intestinal symptoms, the extreme pallor witnessed to by his friends, the presence of profuse sweating, the absence of tongue-

biting and urination are important points. The fact that these attacks occur rarely if ever while the patient is in bed or lying down is often helpful in coming to a correct view of the case and in differentiating the attack from epilepsy.

Fainting attacks associated with heart-block are so rare in soldiers as scarcely to merit consideration from the standpoint of differential diagnosis; fainting attacks in aortic disease are occasional.

The vasovagal attack has a limited significance in prognosis. If repeated it precludes, for the time being, return to work, in pursuing which a man endangers his own life or that of his fellows.

Giddiness.

This is a symptom complained of by three-fourths of the patients of the "effort syndrome" group. It is often experienced at the ending of an effort. The sensation is one of unsteadiness without rotation, and is accompanied by blurring of vision or by the appearance of a shower of bright points of light.

Relation to postural change.—The normal and permanent fall of systolic blood pressure in passing from the lying to standing position is variable, averaging 10 mm. Hg in the brachial artery. In healthy subjects the *immediate* fall is little if at all greater. But in some patients, and especially those in whom there is giddiness on assuming the erect posture, the immediate change may be much more pronounced, and may amount to 30 or 40 mm. Hg.

In considering the effects of this fall of pressure upon the cerebral circulation it has to be borne in mind that there is in addition a fall of intracerebral pressure represented by the

height of the column of blood (from heart to head) in all people when posture is changed. This normal static change of some 25 to 30 mm. Hg becomes a fall of 55 to 70 mm. Hg in exceptional circumstances and is responsible for the symptom of giddiness. In some patients benefit is obtained by supporting the abdomen with a tight and broad abdominal binder.

But the question of postural giddiness in these soldiers is not always so simple as might appear from this account. There are instances of giddiness in which an excessive fall of blood pressure on standing is not to be observed ; moreover, there are rarer instances where giddiness is also experienced on lying down. A number of tested patients complained of equal giddiness when moved on a swingboard into the lying posture (yielding an immediate rise of pressure of 20 mm. in the arm and approximately 45 mm. in the head) and into the erect position. Where men have complained of spontaneous giddiness while standing, the blood pressure during the period of giddiness has sometimes been found reduced, but in several instances it has been raised (by as much as 20 or 25 mm.).

At the ending of effort.—During effort the systolic blood pressure is raised, muscular contractions force blood out of the veins, and the arteries become relatively overfilled. Immediately at the ending of effort the potential reservoir in the veins takes up the blood, the supply to the heart declines, and arterial pressure falls rapidly. In healthy subjects, after several minutes of hard work, the raised pressure falls at once to the original level at the cessation of work ; in patients the fall may be sufficient to produce cerebral anæmia. In the cases considered, giddiness at the cessation of effort is common, actual loss of stability or momentary loss of consciousness is rarer but occurs from time to time.

These types of giddiness have little or no prognostic value. In patients who complain persistently of giddiness, the effects of simple tests, such as quick change of posture, should be observed.

Giddiness of the same types is not infrequent in cases of early structural heart disease, such as mitral stenosis and aortic valve lesions.

Headache.

Headache, frontal and throbbing, and often severe enough to send a man voluntarily to bed, is not uncommon. It is usually an after-symptom of exercise.

Sweating and other peripheral phenomena.

Excessive sweating is frequent and at times leads to complaint. It is frequently to be noticed in the palms of the hands while the patients are at rest, and it is a common experience to note sweat drops trickling from the axillæ, while patients stand stripped in a cool or cold room. Relatively mild stimuli, such as easy exercise or emotion, may produce conspicuous sweating of the forehead and body; in some patients a bedewed brow is almost constant, in a number the skin is greasy or moist. In a few patients the hands stream with perspiration during emotion and are always wet. Such soldiers complain that the sweat constantly rusts their rifles.

Not uncommonly there are other peripheral phenomena in the same class of patient. One of the most noteworthy of these is blueness or mottled colouring of the hands. It is present in a large proportion of the patients and is associated with coldness of the extremities. Dermatographism, simple or urticarial, is common. Attacks of pallor of the fingers accompanied by numbness and by pain are not rare. In a

considerable percentage of the most seriously affected cases, myotatic irritability of the pectoral muscles is present to a conspicuous degree ; the trapezii, scapular muscles and biceps are usually involved at the same time.

Heart rate.

When cases presenting the "effort syndrome" are rested the average heart rate is found to be about 85 per minute in unselected cases. In sleep the rates are for the most part normal.

In patients who are up and about the average is higher, being from 90 to 100 to the minute. Exceptionally, patients present rates of 120 or 130 in the same circumstances, and very rarely the same rates may continue for weeks while the patients are in bed. As a rule, it may be said that the rates approach more closely the rates of health the more rigidly responses to effort and emotion are eliminated. It is clear that the excessive rates found in the majority of these subjects are due to exaggerated response to effort and emotion. In investigating heart rate in them, therefore, and especially in using heart rate in prognosis, the utmost care has to be exercised in rendering uniform the conditions under which these rates are studied.

The heart rate is raised in health by exercise ; the rise varying with the amount of work or the rate at which it is accomplished. The rate is high at the end of exercise and falls gradually to normal. The duration of this fall of rate depends upon the character and duration of the work. In the patients, the response to exercise is similar, but it is called forth by much less effort. Thus, if two 10-lb. bells are lifted through 6 feet 60 times in 120 seconds by a healthy young man, the pulse rate immediately after the task is raised to 150 or 160 per minute. In some patients a rise to a

similar level may be produced by lifting the bells 10 times in 30 seconds. If, in carefully regulated tests, patient and control submit to work that in each produces the same degree of respiratory distress (the patient doing, therefore, far less work than the control), the height to which the pulse rate rises is the same in the average.

The slow return of pulse rate in these cases is notable. In healthy men of military age a brisk walk up 40 steps raises the pulse rate some 20 or 25 beats per minute. The rate falls again to normal in a minute or less. In mild cases of the "effort syndrome," the rise is greater (to 120 or 130 per minute), though the fall may still occur in a relatively short time. In the severer cases the pulse may reach 150-180 per minute and in these it returns slowly to normal; the fall exceeds 2 minutes in its duration. As a general rule it may be said that the exercise tolerance of patients who show at a first examination these exaggerated reactions of pulse rate to exercise proves poor, though there are occasional exceptions. When the pulse rate is relatively low and when it returns quickly to normal after rising, the exercise tolerance usually proves good or fair; but to this rule there are frequent exceptions. In men over 40 a pulse rate raised abnormally by exercise is of greater value, a pulse which maintains normal rates is of far less value, than is the corresponding sign in the young.

Pulse rate as a guide to capacity is to be used circum-
spectly, and the rates obtained from several sources should be compared if they are available. Thus, those obtained on test exercises may be compared with ward rates, and with rates noted as patients return from drills. It is only by using the pulse rate in a broad way that full value is to be obtained from it.

Emotion raises the pulse very easily, a persistent rate of 120 or even 140 during a single and brief examination has little significance. In "effort syndrome," the pulse also shows an exaggerated reaction to posture.

Soldier patients are known to adopt expedients to raise the pulse rate, the most frequent being exercise unobserved by the medical officer (see page 50). Drugging is uncommon; cordite was used by soldiers in the South African war; and thyroid gland to avoid enlistment in the last war.

Blood pressure.

The blood pressure (systolic and diastolic) in the patients at rest is rarely more or less than normal. Exceptionally, patients are discovered in whom there is high systolic pressure (160 to 180) at rest. Relatively high systolic pressures are frequent if the patients are examined while up and about. The relatively high readings are due, as are high pulse readings for the most part, to the exaggerated response to exercise or emotion. If test exercises are employed in normal subjects and the blood pressures are taken immediately afterwards in consecutive readings, the blood pressure, at first low, is found to rise steeply to a maximum (half to one minute after cessation of work) and then to fall gradually. The height of the maximal reading is affected chiefly by the amount of work accomplished; it is also affected by the rate at which the work is done. Similar reactions are discovered in the patients, but the height of pressure reached with a given amount of work is much greater in them. To exemplify, in three controls the lifting of two 10-lb. bells through 6 feet 30 times in 60 seconds raised the blood pressure to an average maximal of 138 mm. Hg (an average rise of only 19 mm. Hg); in two patients submitted to the same test the average maximal pressure reached was 171 mm. Hg

(an average rise of 48 mm. Hg). The facility with which the blood pressure rises in these patients is such as to render isolated observations upon systolic blood pressure unreliable. Such readings cannot be legitimately used. I have known the systolic pressure to rise from normal in patients of this kind to 180 or 200 mm. Hg in the ascent of a flight of 40 steps.

The rise of pressure is also prolonged in the patients, though not so markedly as is the case with the pulse. If patient and control undertake an amount of work producing in each the same degree of respiratory distress (the patient therefore doing less work), then the pressure reached and the amount of the rise is the same in the average for patient and control. The reaction to posture is described on page 33.

Essential hypertension is dealt with briefly on page 78.

Urine.

This often deposits phosphates and urates, after light exercise, thus conforming to the general rule that the reactions to exercise are exaggerated.

V.—PROGNOSIS AND TREATMENT OF EFFORT SYNDROME.

PROGNOSIS.

In considering the prognosis of effort syndrome I shall deal first with our method of resorting soldier patients for further service. Then we shall test this method by examining the military after-histories of such patients, and finally we shall examine the future course of these patients in civilian life.

Physical exercise as a test of fitness.

The chief considerations in sorting trained soldiers for work or duty are those that are relevant in judging capacity to perform their tasks and to endure physical strain. To ascertain without fail whether an individual is or is not fit for a particular form of work is always possible ; but it is possible only when a method is employed that is not always practicable, namely, setting the man fully to his task. This is the only certain method, and it is in general use in everyday life for the selection of people for all kinds of service. But this conclusive method is a slow one and uneconomical. On the other hand, considerations of past history coupled with the physical examination at rest is inadequate. It serves only one purpose decisively, namely, the elimination

of a number of those who, if submitted to the crucial test, would fail or suffer. If you wish to choose a typist, a physical examination will properly eliminate fingerless people; but no physical examination will suffice to ensure that there is speed and accuracy; that requires a test. The same principle applies in choosing soldiers from convalescents; but as the quick method is inadequate and the slow method impracticable, an intermediate method is used.

The method is that of using graded physical exercises. It will be described fully and its value subsequently assessed. But before proceeding to this there are preliminary points to note.

The selection of soldier patients for return to duty is a different matter from the selection of recruits. We are dealing with men already trained, and training represents time and capital; to proclaim a soldier unfit for further duty is to throw both this time and capital away. Again, the men with whom we are dealing are patients; they have broken down on training or on service; at the recruiting stage each man is presumed fit until he is shown unfit; here every man is regarded as unfit until fitness is proved. For these reasons the system of sorting must be much more careful, much freer from error than in any system used to examine recruits. Lastly, the men are in hospital for treatment, it is at the end of the stay, 6 weeks or perhaps 2 months, and not at the beginning of it, that the decision is to be taken. The system to be described meets both purposes, the exercises are remedial and simultaneously they most carefully and effectively sort the men into appropriate groups.

It was proved conclusively in the last war that it is impossible by an inspection of convalescents or by the use

of the stethoscope, to pronounce their capacity to endure prolonged physical strain ; to arrive at a sound conclusion endurance must be tested by exercises of shorter or longer duration ; the conclusion is sound in precisely the degree in which these exercises approach the crucial test in severity. Under the system to be described no soldier is judged fit for duty until his capacity to bear physical strains has been thoroughly tested ; no man is discharged from the Army unless he has shown clear signs of disease or unless, in the absence of such signs, he is proved to be incapable of the work required of him. Under such a system the soldier knows that he has a square deal ; he is quick to recognise the virtue of the plan and to acquiesce in a decision formed along these lines.

All soldiers admitted to hospital are to be submitted to a full physical examination, and within the first few days of their stay all cases presenting unequivocal signs of mitral stenosis, aortic disease, aneurysm, or material cardiac enlargement, etc., are recommended for discharge as permanently unfit. At this examination also are eliminated patients who suffer from manifest diseases of other systems, such as pulmonary tuberculosis, exophthalmic goitre, epilepsy. Briefly, all are eliminated in whom a positive decision can be reached, none are eliminated in regard to whom a divergence of opinion may exist. A few additional patients giving a clear history of repeated or recent attacks of rheumatic fever, showing very high heart rates and great breathlessness, or severe precordial pain accompanied by hyperalgesia, are now eliminated after a relatively short course of exercises. The whole remainder is submitted to more prolonged graded exercises and marches, and the reactions to such exercises form the chief basis upon which the military prognosis eventually relies.

The graded exercises.

The exercises advocated for treating and sorting cases returned to hospital for cardiac disabilities have no claim to be specific. It would not be difficult to devise other exercise schemes that would be equally successful in practice. But any exercise system employed should be based upon certain general principles.

- (a) The drills or games should be graded so that no man is submitted to stiff exercises before his tolerance of easier exercises is thoroughly established. This safeguard for the patient is clearly essential.
- (b) For the same reason, the earliest drills should consist of easy movements and be of short duration. The later drills should consist of stiff exercises and should last longer, approximating in strain and in the kind of strain, as nearly as circumstances will permit, to such exercise as the man is liable to experience after he leaves hospital.
- (c) The drills in the case of the soldiers should consist so far as possible of exercises employed in the service to which the men belong. They are then in large part familiar to the men who submit to them; time is not lost while they acquire knowledge of the movements. Army instructors of physical training are conversant with the exercises and are at once ready and competent to employ them. Lastly, it is only by employing such exercises that the capacity of the men can be thoroughly explored

before they return to duty. The sharpness of the words of command and the quickness of the movements have been subject to criticism on the therapeutic side. It is said, and it is in a measure true, that in highly-strung or nervous men, the sharp command shakes the nervous system; it is also said that quick movements are less beneficial therapeutically than slow movements. It is to be remembered that the exercises are intended to test as well as to treat. The proper reaction to abrupt orders and an ability to move smartly are required of the soldier; in these respects therefore he must be tested. To use separate systems of sorting and treating is not feasible. The introduction of slow movements is inadvisable in anything but the earlier drills; in these they may be used as a therapeutic preparation for the later drills.

- (d) It is wise to break the monotony of the longer drills by short set games in which the competitive spirit is called up and in which the alertness and the intelligent co-operation of the individual make for success. Such games enliven the drills as a whole and render the men more interested, responsive, and willing to work.
- (e) Under really capable instructors the whole of the drills may be replaced by carefully selected games.

The drills advocated are therefore a selection from the official "Manual of Physical Training," which describes them in greater detail; they are grouped as follows:—

DRILL 1. (15 minutes).

- *Foot placing sideways.
Head bending backwards.
Arms sideways stretch.
- *Trunk turning (feet apart).
- *Heels raising, knees bending.
Slow march.

DRILL 2. (15 minutes).

- Arms stretching sideways and upwards.
- *Trunk bending backwards.
- *Knee raising.
Arms swinging upwards.
- *Heels raising and knees bending quickly.
Slow march.

DRILL 3. (30 minutes).

(Consists of Drills 1 and 2).†

DRILL 4. (30 minutes).

(Consists of Drill 2 to which the following exercise is added).

- Arms sideways stretch.
- *Trunk turning (feet apart).
- *Leg raising sideways.
Heels raising, knees bending, arms stretching sideways.
On the hands on ground down.
- *Knee raising quick mark time.
Slow march.

DRILL 5. (30 minutes).

- Arms sideways stretch.
- *Leg raising sideways.
- *Trunk turning (feet apart).
Heels raising, knees bending, arms stretching sideways.
Lying on back, arms upward stretch, legs raise.
Arms stretching upwards, trunk bending backwards.
Arms stretching sideways upwards.
On the hands on ground down, arms bend.
Trunk forward bend, arms stretching sideways.
Slow march.
- *Knee raising quick mark time.
Arms swinging upward.
On alternate feet hop, or upward jumping.

A breathing exercise is useful (arms raising forward and upward, lowering sideways and downwards) to begin a drill, and head bending backwards may be introduced at times to bring the class into good posture.

Men on drills 2 and 3 are sent for slow route marches of 1-2 miles in the afternoons and are entitled to subsequent passes from the precincts of the hospital.

Men on drills 4 and 5 are sent for longer route marches (4-5 miles) at an ordinary marching pace and are entitled to longer passes from the grounds of the hospital. The men on drill 5 enjoy additional privileges.

* These exercises may be preceded by "hips firm" to advantage.

† The object of using drills 1 and 2 again is to reduce the number of movements to be remembered.

All drills and games are conducted in the open air whenever the weather permits of it.

At suitable intervals all men are examined as they come from exercise. It is understood that any man who feels his drill or march to be beyond his power is to report at once to his medical officer. The drill instructors are ordered to report upon men who seem to them to tolerate exercise badly and, on the other hand, upon any who fail to make reasonable effort. Co-operation between the medical officers and the instructors is an essential feature of the system, and much is left to the instructor's discretion. It is the habit of most medical officers to see each man immediately after he has taken the first drill of each grade ; other officers prefer to raise the grade more automatically, and to await complaints from such men as feel themselves hard pressed. At the examination, whether it be at the dictation of the medical officer or drill instructor or at the wish of the man, questions of a general nature only are asked ; the rule is to allow the man to tell his own story ; it is inadvisable for the officer to introduce any symptom into the conversation. Notes are kept on simple forms ; each symptom complained of is entered, as are corroborative signs and readings of pulse rate, etc.. This sheet forms in the end a summarised history of the work accomplished and the reaction to it. In the average, one or two examinations of each man are made weekly directly after exercise. Medical officers are careful to conceal so far as possible the particular symptoms or signs upon which they mainly judge tolerance.

Signs and symptoms after drill.

The chief complaints of the men as they come from drill are of breathlessness, fatigue, precordial pain, palpitation and giddiness. It is essential that objective evidence of symptoms should in each case be found before a complaint

is allowed to weigh. Most patients emphasise a single symptom, and emphasise it constantly; a changing symptomatology can rarely be corroborated by outward signs and is to be distrusted. Some men complain on all occasions and in equal degree from the lowest to the highest exercise; others complain little. The medical officer has ever to be on his guard against those who exaggerate their sensations and equally on his guard against those who are reticent. The tolerance of exercise is to be judged by physical signs and not by symptoms; symptoms are chiefly of value in directing the attention quickly to physical signs. If a medical officer lays recognisable emphasis upon a particular symptom he is apt to provoke a corresponding epidemic in his service.

Facial expression and breathlessness.—The facial expression when it exhibits genuine distress is generally that associated with breathlessness. The accessory muscles begin to be called into play, the nostrils are expanded, the tendons of the sterno-mastoid lift and the lips part a little; where there is greater distress the *alæ nasi* are active, the eyebrows are drawn together, furrowing the forehead vertically and yielding an expression of anxiety or pain, the mouth opens wider and its angles droop and the breathing is more audible. If questions are asked, the breathing is ill-regulated during the replies, the flow of words is interrupted by inspiratory movements. Not infrequently, and especially where there is fatigue, a slight but distinct duskiness develops under or around the eyes, pallor or sallowness of the face is not unusual. The facial traits deserve careful observation, for they cannot be simulated; rapid breathing is by itself a scarcely sufficient evidence. In a few patients in whom distress has been frequent and has been experienced for long periods, the altered facial expression is maintained at rest.

A complaint of *fatigue* or *exhaustion* is rarely unaccompanied by other complaints, and may be disregarded unless often repeated and accompanied by signs such as pallor, uncontrollable tremor of lips or limbs, or breathlessness, as the grade of exercise is raised.

Precordial pain.—This complaint is frequent ; it is to be checked by physical examination. With the chest of the patient stripped, the hands of the examiner are placed or spread symmetrically on the axillary and submammary regions, and pressure is exerted as though to steady the chest or to bring the patient to a more convenient position. This simple action may be sufficient to disclose hypersensitiveness ; in some patients, indeed, the slightest pressure on the left precordial region and a wide surrounding area is resented. In others it is necessary to slip the hands higher, bringing the thumbs over the border of the pectoral muscles and pressing again, or to proceed further, and, while interrogating the patient, to grasp the pectoral folds with increasing firmness between the thumbs or fingers. Where the muscles are sensitive on the left side the patient winces, the left shoulder is depressed, the facial expression alters or the reply is momentarily interrupted or actually broken off by a movement or expression of protest. Patients should not be asked, is this or that region sensitive ? When no hypersensitiveness of the left chest wall is detectable after exercise, the plaint of pain may usually be neglected. Hyperæsthesia is most conspicuous in men recently admitted. Pain in the axillary region, back, or limbs is usually related to a particular action on drill and, as a rule, does not endure.

Palpitation.—A complaint of palpitation after exercise is to be neglected as such, but it is serviceable as a guide to persistent or excessive tachycardia. The rate may be normal, raised, or very high. To give actual rates might create a

false impression. Heart-rate cannot be used by rule of thumb; rates vary too much with circumstances, and in general it is impracticable to render these uniform. However, the conditions pertaining to a particular hospital service may be maintained sufficiently constant for different patients and at repeated examinations of the same case. It is essential that heart-rates should be regarded broadly, and particular emphasis is to be laid upon consistency of separate readings. Thus, a patient who reports himself as disturbed by a given drill will usually show uniform high readings after that drill if distress is genuine; and these high readings will be foreshadowed by raised rates after drills of lower grade. Equally important is consistency between these drill rates, the routine ward rates, and the rate obtained by test exercises.

Fainting, etc.—Although over 5,000 patients were submitted to graded drills at our Colchester hospital during the last war, there was no single accident of consequence. In the square where 500 men were drilled daily, one man fell perhaps in two or three weeks. The true faint is accompanied by pallor. An appreciable increase in the numbers of faints at soldiers' parades is to be regarded first from the standpoint of malingering.

In some attacks on the drill ground the face is flushed, consciousness is not lost, the breathing is noisy and ineffectual, often sobbing, the face contorts, expressing not distress but irritation or vexation; the body is held rigidly and such movements of the limbs as occur are for the most part purposeful. The eyelids are held tightly shut, and the opening of them is resisted. Such manifestations may be assumed, but are more usually displayed by psychoneurotic patients; these attacks are apt to coincide with the visits of medical officers to the parade ground.

As a rule a fainting attack should not break the routine of drill for more than forty-eight hours.

Simulation.—If it were wise to do so, it would be impossible to hide the meaning of the exercises or their use for sorting purposes from the soldier patients; they come to understand the significance of any deliberate special examination. Complaints of distress where absolutely no distress exists are on the whole rare. Such complaints do not deceive; the manner of their presentation awakens doubt; they are unaccompanied by objective signs or the signs are incompatible with the complaint.

The over-emphasis of symptoms actually experienced is more difficult to recognise and is common; it is recognised by the same careful comparison of the objective and subjective. Medical officers will be well advised to guard against wilful efforts to produce or to exaggerate signs of distress. A man returning from exercise to the medical officer's room will from time to time sprint on the flat, dash upstairs, or perform vigorous exercises before entering the door and presenting his wrist for examination. But such attempts are not easy to maintain, and repetition is essential to their success. The man must repeatedly risk detection by a member of the staff, or maybe fails to find his opportunity; in the last case his observed reaction is out of harmony with former reactions. The genuineness of a sudden increase in the reaction to exercise is to be tested by visiting the man while he is at drill, or by imposing simple exercise tests in the examination room. The constant supervision of drill by medical officers is both unnecessary and inexpedient; the men work better and more uniformly when left to the drill instructor. No doubt the voluntary production of distress is overlooked from time to time in individual cases, but it cannot long be concealed from the man's comrades,

and many of these will resent the deception. If less gross, the deception may be contagious, and comes to be practised by small groups of men ; its early discovery is from that time certain. When discovered, it is met at once by placing the man or men upon a higher grade of drill without comment.

The other and brighter side of the picture is the man or men who steadily refuse to complain ; these tax the medical officers' power of discrimination most of all. Medical officers who get to know their men, who can win their confidence, who treat them tactfully and fairly, experience little difficulty. Most patients desire only full examination and consideration and will recognise the justice of the final decision, understanding for themselves that they are judged for grade of service according to their proved tolerance for work.

Grading.—“ Effort syndrome ” cases that progress to the highest exercises and carry them out without distress in conjunction with route marches may be sent to full duty ; men who progress more slowly and those who tolerate the highest grade of exercise less perfectly should be sent to depots for further training, or are recommended for suitable light duty categories. Men who show symptoms and fail to improve on the lower grades of exercise are to be recommended for sedentary duty or discharged as permanently unfit from the Army. In classing men and in recommending categories of duty it is wise to maintain the standard of recommendations uniform by analysing the percentage results at regular intervals. The class of case was not found to vary appreciably during the period of the last war. The actual percentage figures of patients leaving hospital approximated to the following :—

Fit for general service	20%
Fit for hardening or labour	30%
Fit for light or sedentary work	30%
Permanently unfit	20%

Military after-histories.

The final basis of any system of prognosis is experience. The prognostic value of any symptom or sign, in so far as it affects the military after-history can be ascertained accurately within twelve months following the discharge of a selected group from hospital. Such statistical work lifts prognosis to a level of exactitude and raises the efficiency of the system of sorting to which it refers.

After-histories of 1916.—Between May and November, 1916, 272 men were recommended on the basis of graded exercises and marches to one of several duty categories. The actual recommendations are given in the left-hand column of the table, as they apply to 239 of the 272 men.* These are all the men of the group for whom a satisfactory comparison between the recommendations and after-histories can be instituted.

An average period of 11·2 months elapsed between discharge to duties and the receipt of the replies. The table may be summed up. 119 were recommended as fit for duty (72) or likely to prove fit within three months (47); 109 men had proceeded on full duty overseas (79) or were in provisional units (30); 120 men were recommended for light or sedentary duty; 87 men were performing these duties when the replies were received. Of the whole group of 239 men, only 38 had been discharged as permanently unfit from the Army after leaving hospital, 5 additional men were unfit in lesser degree and were under treatment, 16 men were on sedentary duty at home. Compare the recommendations with the after-histories; it establishes the soundness of the sorting system employed. The system at this its preliminary trial proved

* Thirty-three men have been omitted; in 9 of these no after-history could be obtained. One man had been discharged as time-expired; 1 had deserted. The remaining 22 had been transferred to Reserve classes, namely, as fit for service but deemed of greater value in civil life.

After-histories of 239 men.

<i>Recommended.</i>	<i>Disposition after 11 months.</i>
72 Fit for general service.	35 in the firing line
	23 not known if in firing line.
	21 known not to have been in firing line.
	} 79 full duty overseas.
47 Likely to be fit for general service within three months.	30 in provisional units.
	8 on full duty home service.
20 Light duty, unlikely to be fit for overseas within three months.	7 light duty overseas.
	23 labour companies at home.
68 Light duty, but unlikely ever to be fit for service overseas.	33 light duty home service.
	16 sedentary duty at home.
	5 under treatment.
32 Sedentary work at home.	38 discharged permanently unfit.

sound because its basic principle, the sorting of men for physical work by testing them at physical work, was sound.

The actual after-histories of the 239 men may be considered in more detail. Of the 86 men who proceeded overseas, 35 are known to have reached the firing line, 44 others are entered in the table as having been on "full duty overseas" and 7 on light duty overseas. It is desirable to consider the first two sub-groups further. The records of the 35 men known to have reached the firing line were as follows:— 8 men were wounded one or more times, and were evacuated for their wounds; 4 became "prisoners of war"; 8 were still in the firing line and had been there for an average period of 4 months at the time the replies were received; 2 were in the trenches for an average period of 2½ months and were evacuated for shell-shock and trench fever; 4 were in the trenches for periods varying between 3 and 22 months and were eventually sent down for a recurrence of the old symptoms; the remaining 9 failed to make good in that they reported sick and were placed on light duty before they had been one month in the trenches. Thus, of the 35 men known

to have reached the firing line, 26 may be considered to have made good. These figures are to be read as representative.

The 44 men entered as having been on full duty overseas are subdivided as follows :—

<i>"Full duty overseas" group.</i>													
23 not known if in firing line	<table style="border: none;"> <tr> <td style="font-size: 3em; vertical-align: middle;">{</td> <td style="padding-left: 10px;">(1) Evacuated for "effort syndrome" ...</td> <td style="text-align: right; vertical-align: bottom;">4</td> </tr> <tr> <td></td> <td style="padding-left: 10px;">(2) Evacuated for other reasons...</td> <td style="text-align: right; vertical-align: bottom;">3</td> </tr> <tr> <td></td> <td style="padding-left: 10px;">(3) Further history unknown ...</td> <td style="text-align: right; vertical-align: bottom;">16</td> </tr> </table>	{	(1) Evacuated for "effort syndrome" ...	4		(2) Evacuated for other reasons...	3		(3) Further history unknown ...	16			
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To sum up, 239 men, 86 (or 36 per cent.) passed overseas within shorter periods than 11 months. A further number, 30 (or 12 per cent., making 48 per cent. in all), were in provisional units before the end of 11 months. Of those passing overseas—namely, 86 men—the percentage reaching the firing line is not precisely known; it was as high as 41 per cent. and less than 75 per cent.; the intermediate figure, 58 per cent., may be taken as an approximation.

It would seem clear from the figures given that sorting of this large class of soldiers can be eminently successful; and medical officers who have experience of graded exercises appear to be of the unanimous opinion that they are essential both to efficient sorting and to efficient treatment.

Incomplete after-histories of 1918.—The following after-histories apply to a group of 1,080 "effort syndrome" cases finally dealt with at Colchester during the months of January to May, 1918. These men were all patients received from the Overseas Forces. Of the whole number, 192 (or 18 per cent.) were discharged as permanently unfit for any form of duty from our hospital. The remaining 888 men were sent out as follows :—(i) 224 (or 21 per cent.) to their regimental depots as fit for general service after hardening;

(ii) 353 (or 32 per cent.) to command depots for further training and sorting to full duty, light duty, etc., and (iii) 311 (or 29 per cent.) to their regimental depots as suitable for light employments and sedentary work.

Month by month, inquiries were sent out in respect of these 888 men, and the table shows the disposition of 860 of these three months after they left hospital.

Disposition of 860 "effort syndrome" cases three months after being sent to duty. (January-May, 1918.)

<i>Disposition.</i>	Numbers.	Percentages of 860 cases.
Overseas	100	12
Provisional units and full duty home service	180	22
Labour companies	46	5
Light and sedentary duty	261	30
Still at command depots	131	15
On the reserve as of more value in civil life ...	17	2
Dead	1	—
In hospital	43	5
Discharged after leaving hospital	81	9
Totals	860	100

This batch of after-histories was the most favourable obtained ; 12 per cent. of the men sent to duty were on full duty overseas within three months of leaving hospital ; 22 per cent. were in provisional units or on full duty at home, making a total of 34 per cent..

Course on return to civil life.

After the armistice of 1918, a series of more than 600 patients, who had passed through the Military Heart Hospitals, had been diagnosed as "effort syndrome," and had been discharged from the Army before or after a return to duty,

were followed. The men varied in age from 17 to 50 years at discharge, the largest group being between 21 and 30 years. The group was representative, the only factor influencing the choice was residence; the group being limited to the London area to keep contacts and help examinations. Each of the men was followed year by year for a period of 5 full years from discharge. In some it was continued for 2 more years; this confirmed the general trend of results of the 5 year period. Because these men were all pensioners, and living within reach, only a small percentage remained untraced and the statistical results are therefore reliable. The 601 with whom contact was kept, are reviewed in the accompanying table and comments which follow. As this table indicates, 15 per cent. of the whole group were quite fit at the end of the 5 year period, and another 18 per cent. had improved in health; 56 per cent. were unchanged; a small percentage had become worse in health without disease showing itself; in about 9 per cent. serious, acute or chronic, disease had developed; there had been a few deaths.

First it is to be said that the majority of patients suffering from "effort syndrome" remain in a state of imperfect health without developing serious disease; after the Army life they retire to civilian life and to their old occupations. The standard death rate in the whole group showed no significant divergence from that of a similar age group of the general population of London, of the same period. Of diseases developing, only pulmonary tuberculosis was frequent; its incidence was 80 per cent. above the standard notification rate for London in the same period. Among the 601 cases, 1 case of mitral stenosis, and 2 cases of aortic regurgitation were detected at the end of 5 years. Thus the incidence of pulmonary tuberculosis is alone noteworthy in "effort syndrome" cases.

Arranging the cases in sub-groups, into those originally presenting systolic murmurs and those without such murmurs, after-histories were substantially the same; this was true whether the murmurs were heard at the base or at the impulse; it was also true of those presenting loud conducted murmurs, murmurs that have so often been thought in the

After-histories (after Grant) of "effort syndrome" cases returning to civil life after the Great War. State after 5 years. Percentage figures.

Groups	No. of cases	Fit	Im- proved	Station- ary	Worse	Incidence of serious disease*	Dead
No cardiac signs	266	16.9	15.4	57.2	2.6	10.1	2.3
Apical systolic mur- mur non-conducted	208	14.4	19.7	53.4	4.8	10.1	1.9
Loud apical systolic murmur conducted to axilla	25	16.0	16.0	68.0	0.0	1.0	0.0
Basal systolic murmur	79	13.9	22.8	55.7	2.5	11.3	0.0
Impulse diffuse	71	15.5	19.7	52.2	5.6	8.5	4.2
Whole group	601	15.3	17.8	56.2	3.2	8.7	2.3

* These diseases include 20 cases of pulmonary tuberculosis, 4 pneumonias, 3 appendicitis, 3 chronic bronchitis, 2 rheumatic fever, etc., in many of these cases the acute illness passed away and the case is then entered also in another column of the table.

past to mean serious disease of the mitral valve. There was also no substantial difference in the after-histories of those showing diffusion of the impulse.

The after-histories of cases returning to civil life were in general consistent with the military after-histories.

TREATMENT.

During the early period of the last war, patients suffering from "effort syndrome" were regarded as heart cases and were treated largely as bed cases and, when up and about, with undue caution. Their average stay in hospital was 5·3 months. This delay was due to the exaggerated idea prevailing as to the seriousness of the malady, to the lack of clear lines of treatment, and to the indecision of medical officers who were unable to decide as to the fitness of the men for duty, and delayed accepting the responsibility of returning them to duty or of discharging them. Patients were frequently transferred from one hospital to another, staying a long period uselessly at each. As bed cases and under a slack régime these patients deteriorate in health, and become undisciplined in mind and body; the difficulty of disabusing their minds of the notion that their hearts are diseased increases. The terms of army diagnosis "V.D.H." and "D.A.H.," which were applied indiscriminately in those days impressed the cardiac diagnosis as the cases were passed from hand to hand; for to the average civilian, then and now, heart disease is synonymous with chronic invalidism at the best. Undoubtedly the symptoms constitute a very real disability in a large percentage of the soldiers, rendering them temporarily or permanently unfit for active duties; but the reiterated use of cardiac terms in describing them is baneful, conveying both to patient and medical officer a quite wrong impression. I hear of men with sound hearts, but increased heart rate and breathlessness, who are coming from France in this year 1940, openly labelled cardiac.

I can best illustrate the old attitude towards "effort syndrome" by describing the first trial of exercise upon them in the summer of 1915. At the first drill the medical officers, themselves all chosen for their experience in cardiac work, each paraded two men; every officer attended the first drills, and as each exercise was completed the men were called out of the ranks and anxiously scrutinised for rise of pulse rate and signs of dilatation, etc.. No deleterious signs were found, but it was with the utmost caution, and with constant examinations of all the men exercised, that the drills were increased in length and severity. Experience, and experience only, broke down the former timidity and broke it so completely that at Colchester, in the later periods of the war, 500 men were drilled daily under the sole supervision of army instructors in physical training. So strong was the traditional teaching and attitude towards "disordered action of the heart," so emphatically was it emphasised by army terminology, and so firmly was it supported by hypothesis of "heart strain" and acute dilatation of the heart in exercise, that we dealt with these cases, labelled for us already, as though their condition was strange and treacherous, failing to perceive that civilian practice presented us with cases of an exactly similar kind almost daily.

No man who is retained in the Army should be allowed to believe that his heart is weak. It is a first step in treating "effort syndrome" cases to bring home to them that they are the subjects of no serious disease; and above all to discountenance the idea that the heart is at fault. Their symptoms should be ascribed to a temporary and unserious state of ill-health, a general lack of tone and fitness. The attitude to the patient should be one not of diffidence but of confident optimism. Their demonstrated capacity to exercise supports this attitude.

Under a free régime in which the men are sent out of doors, are required to take appropriate physical exercise, and are encouraged to amuse themselves actively in spare time, the course of the "effort syndrome" is in a large number of patients towards recovery. The exercise and outdoor life lead them back to a more vigorous habit of mind and body. The men see the progress of their comrades toward health; they feel progress themselves. It is preferable that such a régime should be imposed as soon as possible after the men report sick. It is not a question of their being placed at once on heavy exercise; it will be the rule that tired men from the fighting areas, are maintained for a week or a little longer on the lightest drills; but it is unwise to excuse them from these light tasks. In the convalescent hospital, and that is what the military heart hospital should be, promptitude should be the rule; decisions for treatment should be taken without delay, but the treatment once decided upon must be unhurried, and must be maintained so long as there is reasonable prospect of further progress. The average period of treatment required should be no more than 2 months from the time of entering hospital; some cases will stay a longer, some a shorter time.

In the last war, an early change for the better was especially noticeable in men returned directly from the fighting areas. In these it was the rule to find much improvement during the first week or so under the new régime. This quick and usual advance towards health was due in part to the removal of those causes, which in the war areas, increased the symptoms, namely, the tension and anxiety of mind, the arduous physical work, irregular meals and sleep, and the exposure of the body to wet and cold. Men who came from abroad enjoyed for a time a blessed feeling of security, itself a powerful sedative and undoing the

ill-effects of the old mental and physical strains. But improvement also occurred, though not at the same rate, among men sent to hospital from the home forces.

In a group of the patients the initial improvement continues and health is soon completely restored; oftener initial progress becomes slower and several or many months elapse before the symptoms sufficiently abate to allow return to active duty. In most patients, progress occurs to a point and stops, health remaining impaired or unfully restored. It may be said that the health of the men as a group is raised, and more than slightly. Those who on admission are mildly affected reach or almost reach a state of fitness; those who on admission are severe cases do not as a rule return to high grades of duty. It is the shift towards health in the group which brings the more favourable out of the borderland of ill-health, rather than to startling progress in single cases, that the success of the method is due.

Great improvement has followed the finding and treatment of a local source of poisoning. The most notable examples have been cases of amœbic dysentery, of latent gall bladder infection, of chronic appendicitis, and of septic conditions of teeth or tonsils. Local infections therefore should be sought for and efforts made to cure them.

Treatment of the chief symptoms by means of drugs is ineffectual. Many such remedies have been tried unsuccessfully. The work of the dispensary should be limited to the compounding of laxatives and such minor remedies as relieve headache or aches in the chest. In occasional cases a tonic or sedative may be given; but in the main the patients are to be kept away from medicine bottles.

VI.—DIAGNOSIS OF DISEASE OF THE HEART IN SOLDIERS.

The detection of disease of the heart in young soldiers consists largely in discovering cardiac enlargement, disease of the valves in the form of mitral stenosis or aortic regurgitation, occasional cases of congenital heart disease, grave irregularity of rhythm, or failure with congestion. In older men high blood pressure, aortic enlargement, and angina pectoris are the chief additional maladies rendering men unfit as soldiers. With the diseases of young men I shall deal at some length from this standpoint; those of older men must be dealt with more in the form of notes bringing out the salient points in army medical work.

Enlargement of the heart.

The heart may be enlarged because its cavities are dilated, or because its walls are increased in mass or hypertrophied. In patients in a stable condition physical signs in the chest will not differentiate clearly between these two changes. If a heart signals its enlargement in the space of a few hours or days, dilatation is surely present. Evidence of dilatation is to be found in a change rather than in specific signs taken from the chest wall. Where the heart is permanently enlarged dilatation and hypertrophy nearly always co-exist, and it is unnecessary to differentiate. The presence or absence of "compensation" as it used to be called, cannot

be assessed from the chest wall; instead we examine the neck to ascertain if the veins are filled to the normal or to an unusual height (see page 77).

When the heart is materially enlarged the man is unfit for any but light work; thus, to estimate the size of the heart in soldiers is very important.

Clinical signs of enlargement.

In examining a heart the man should be first in the erect posture.

The maximal impulse.—The heart's impulse in the healthy chest of a young man, standing erect, is usually confined to an area about 1 inch in diameter, situated in the 5th interspace and 3 to 4 inches from the middle line. The value usually given, $3\frac{1}{2}$ inches, is insufficiently elastic. The nipple line, also used as a guide, is sound in that in large men the nipple is more distant from the sternum and the impulse normally travels out with it. Sometimes the impulse will move outwards a little when the subject lies down, much more often it moves inwards. The impulse is visible; and it is palpable, the finger feeling not a mere flicker but a distinct but slight thrust in systole. The outermost limit of this circumscribed area, in the recumbent subject, is the best clinical guide we possess to the left border of the heart, and to the size of the organ. When the heart is unenlarged, it corresponds very accurately in most cases to the left limit as depicted by the X-ray screen.

A well defined maximal impulse, the outer border of which is more than $4\frac{1}{2}$ inches from the midline, or clearly beyond the nipple, is to be construed as a definite sign of cardiac enlargement, provided the heart is not displaced. The sign is more emphatic if the impulse is in the 6th, and

less emphatic if it is in the 4th, space. In great enlargement it is found in the 6th or 7th space near the middle or hind part of the axilla.

Diffusion of the impulse.—A diffuse impulse is often to be found in soldiers. It may be seen extending from the 5th to the 4th and 6th, and even to the 3rd and 7th spaces, and covering much of the precordial region. This diffuse impulse has been a frequent source of error in military diagnosis and prognosis, it being thought to indicate dilatation of the ventricle. It is true that it may accompany dilatation, but it is generally produced by a quick systole and associated with an enhanced rate of beating. Some diffusion of the impulse occurs normally when the heart's activity is increased by exercise, or by excitement. It also occurs when the heart is uncovered by retraction of the lung. No impulse, however diffuse it may be, which is confined within the nipple line can be used to diagnose enlargement; an X-ray will usually show that enlargement does not exist. If the diffuse impulse has spread out into the axilla a maximal impulse will be found at or towards its outermost margin. The size of the heart should be gauged from the position of this more palpable impulse, and not, as has been taught commonly, from the lowermost and outermost point of visible pulsation. In these cases it is surprising how far the impulse will sometimes move inwards when the subject lies down.

The civil and military after-histories of many of these men presenting diffuse impulses have been compared with those of men with local impulses; other things being equal no difference is to be found in the men's capacity to work or fight.

Movement of ribs or sternum.—The transient shock of the heart, which gives the diffuse impulse in soldiers without

cardiac enlargement, is usually too feeble to lift the bony or cartilaginous structures of the chest wall, though it may vibrate them. A palpably sustained movement of the ribs, or of the lower sternum, is usually to be regarded as signifying enlargement. This is so even if the maximal impulse is in its normal place. Simple augmentation of the heart-beat, though often producing diffusion of the impulse in the spaces, rarely moves the hard parts of the chest wall appreciably.

Epigastric pulsation.—This pulsation is of little value in diagnosing enlargement of the heart. It may come from the aorta or from the right ventricle; in the first case it is systolic and in the latter usually diastolic. The ventricular pulsation is frequent in normal young men, especially when the heart's action is augmented.

Percussion of the heart.—The left border should be percussed in the 5th, sometimes in the 6th, interspace from left to right with moderately firm strokes, starting well out in the axilla. A left margin of dulness usually coincides with the maximal impulse. If the margin disagrees with the outer border of the impulse, it is safer to accept the latter. The outermost normal limit is $4\frac{1}{2}$ inches from the midline. The sign is mainly of value where no impulse can be detected.

In marking the right margin of dulness, the upper border of the liver should always be percussed first and in the right nipple line; percussion is then carried inward just above the liver dulness until that of the auricle is met. It is usually met $1\frac{1}{2}$ to 2 inches from the midline. Percussion in the 3rd or even 4th right spaces usually finds no dulness. The right margin of dulness has chief value in telling if the heart is displaced or not.

In subjects over 40 years, the 2nd space should always be percussed, both to right and left of the sternum. This space should be resonant throughout, as should the sternum at the same level. It is a far better routine than attempting to determine the upper border of dulness; for it detects enlargement of the aorta.

Murmurs. Diseases of valves.

Murmurs are to be heard over the precordium in more than half the soldiers sent to military hospitals for acutal or supposed cardiac affections.

Cardio-respiratory murmur.—This murmur is quite the most frequent. Usually of maximal audibility near the apex, it is often to be heard over a wide area of the precordium and in many cases is distinct in the axilla and at the angle of the left scapula. It has been responsible for many quite wrong decisions to discharge soldiers from the Army as permanently unfit. It is a short high-pitched, rather superficial whiff, which is audible or most audible only in the inspiratory period of respiration. In reality it is a breath sound, the normal vesicular murmur being broken into two, three, or more short murmurs, each of which accompanies a cardiac systole. The cardio-respiratory murmur, as it is called, is usually associated with rapid heart action, whence its prevalence in cases that present the "effort syndrome." But it may be heard when the heart action is relatively slow and it is not necessarily confined to inspiration; it may occupy expiration also, and in rare cases continues even when the breath is held. In the last circumstance it is recognised by its character and by its accentuation during inspiration. The murmur has no diagnostic or prognostic significance. It is a natural accompaniment of an overacting heart and as such it should be construed.

Pulmonary systolic murmur.—The next commonest murmur is a systolic bruit, soft or harsh, and audible over the 2nd, 3rd, or 4th left costal cartilages. Frequently it is audible only when the patient lies, usually it is accentuated in the supine posture. It has no prognostic significance, but may be used in diagnosis to remind the examiner that the heart's base should be felt for thrills.

Pulmonary stenosis is never to be diagnosed unless a thrill, maximal in the region of the 2nd or 3rd left cartilage, is distinctly palpable or unless the patient also shows cyanosis of the lips, permanent or transient. The lesion is a serious one, but is rare.

Patency of the ductus arteriosus is another rare lesion. It may be diagnosed when a murmur is heard in the region of the 2nd or 3rd left cartilage, which murmur runs without break through systole well into or through diastole. Such murmurs are almost always accompanied by thrills. The condition is not serious in itself but is often associated with, and hides the signs of pulmonary stenosis or other congenital defect.

Aortic systolic murmur.—Less frequent than the pulmonary systolic murmur, the aortic systolic murmur has no greater significance. Emphatically it is not to be taken as a sign of aortic stenosis, whether regurgitation is present or not. Almost all stenosis cases present a systolic murmur it is true; but it is also true that very few men of military age presenting systolic murmurs are affected by stenosis. It may be used to remind the examiner that he should feel the heart's base for thrills and the pulse for its character. Prognostically the murmur is valueless.

Aortic stenosis.—To diagnose aortic stenosis regurgitation should be diagnosed first. The diagnosis of the former in the absence of the latter is always difficult. Given a diastolic

murmur, then stenosis may be recognised when a systolic thrill is found at the level of the 2nd cartilage and the pulse is slow rising or anacrotic in character. In aortic stenosis the systolic blood pressure is lower and the diastolic pressure is higher than would be the case if aortic regurgitation were uncomplicated. These are the only signs that are at all reliable. The diagnosis of stenosis has not much purpose from a military standpoint once regurgitation has been recognised.

Apical systolic murmur.—The commonest apical murmur is the cardio-respiratory and this is usually well heard far into the axilla, and is often conspicuous at the angle of the left scapula. A systolic murmur audible only while the patient is in one posture, standing or lying, but usually the latter, is next most frequent. Some systolic murmurs vary much in intensity and in quality from day to day, others are almost constant with change of posture and at repeated examinations. Naturally perhaps, those that are most constant are most suspect to be of endocardial origin; nevertheless a friction sound, resulting from a thickened pericardial surface, may possess the same constancy; and endocardial murmurs sometimes show inconstancy. There is a widespread tendency to ascribe the harsher murmurs to regurgitation. None of these qualities or relations offers a reliable means of differentiating. Almost any type of systolic murmur may be heard, a soft blowing murmur, a harsh rasp, a musical bruit, and at autopsy no fault may be found with the mitral valve or ring. The valve may be defective, or the ring may be wide, and there may be no murmur.

Mitral regurgitation.—The diagnosis of mitral regurgitation from the characters or conduction of the systolic murmur is uncertain; it is more certain where a murmur suspected

of being due to this cause is associated with a history of rheumatic fever. Assuming regurgitation, the diagnosis of its cause—a damaged valve, a weakened muscle—is still problematic. If we are sure that mitral reflux occurs in any group of heart cases, then we are sure of it in cases presenting the signs of mitral stenosis. Yet in these the systolic murmur is variable in its occurrence, in its character, and in its conduction. The first task of those who would use these systolic murmurs for purposes of prognosis is to differentiate those produced in the air passages (cardio-respiratory); the second task is to differentiate between those arising in the pericardium and those arising within the heart, no easy matter; the third task is to differentiate two classes of murmur arising inside the ventricular cavity, namely, those due to a lax ring and those due to a damaged valve; this last differentiation is impossible if the characters of the murmur are alone considered. The difficulties inherent in the diagnosis of mitral regurgitation have been discussed sufficiently; the diagnoses are insecure; the degree of regurgitation when it occurs cannot be gauged. Since the diagnosis when made hangs exclusively upon one sign, we shall be more logical if we consider the significance of the murmur rather than that of regurgitation. This will be discussed presently in dealing with systolic apical murmurs in general.

Tricuspid systolic murmur.—A systolic murmur heard at its maximal intensity over the lower part of the sternum or ensiform region is usually ascribed to tricuspid regurgitation. This murmur is less common than those already described in patients who present the “effort syndrome.” Strenuous exercise is sufficient to produce a murmur over the ensiform cartilage in some healthy people. The value of the tricuspid systolic murmur in prognosis is negligible.

Systolic apical murmurs are to be neglected, in arriving at a prognosis in young men. We are here considering murmurs that have persisted. I exclude a systolic murmur, and particularly a systolic apical murmur, which appears during the course of an acute illness; for such murmurs always indicate a change in the patient's state, and the apical murmur is then usually to be interpreted as due to early ventricular dilatation.

In considering the significance of the persistent systolic murmur, we are concerned not with theory but with plain fact. If an unselected group of men is taken and these all have systolic murmurs, and an equal group is similarly taken without murmurs, there is no doubt that the prognosis is better in the second than in the first group. But such a comparison tells us nothing of the significance of murmurs, for many of those with murmurs will present symptoms and other signs, themselves of significance. If the two groups are selected so that they are alike in every other respect, if there is nothing in either group beyond murmur, or if in the two groups the incidence of breathlessness and of rheumatic fever, etc., is the same, then the prognosis for the two groups is the same. From a large group of soldiers invalided to military heart hospitals for breathlessness, all cases of severe heart disease, and all giving a history of repeated or recent rheumatic fever and serious intolerance of physical exercise, were eliminated, and the men then divided into two groups, namely, those with and those without systolic murmurs. Exercise tests showed the one group to be as tolerant as the other. The two groups were found to be of equal value for military purposes subsequently.

Since the year 1918, a more extensive comparison has been made of after-histories of two such groups over a period of 5 years. The results (see page 57) substantiates

After-histories of "effort syndrome" cases with and without systolic murmurs.
(Disposition 11 months after going to duty in 243 cases.)

Percentage figures.

	Pre- senting no mur- murs (90 cases)	Pre- senting mur- murs (76 cases)	Apical murmur (34 cases)	Basal murmur (15 cases)	Apical and basal (20 cases)	Other mur- murs (8 cases)
Firing line	17	14	12	13	25	0
Full duty overseas	21	20	18	27	10	43
Provisional unit and full duty home service	18	14	9	0	30	14
Light duty overseas	2	1	3	0	0	0
Labour companies	11	12	12	13	10	14
Light duty home service ...	22	22	26	27	20	0
In hospital	2	4	6	6	0	0
Discharged permanently unfit...	7	13	15	13	5	28

The table gives in its first two columns the after-histories of patients with and without systolic murmurs in percentage figures. Actually the patients presenting no murmurs do a little better than those exhibiting murmurs; thus 17 per cent. of the former and 14 per cent. of the latter reach the firing line. But the difference is trifling; of patients presenting only apical systolic murmurs (3rd column) those reaching the firing line number 12 per cent., a fall of 5 per cent. as compared with patients presenting no murmurs; the figure for "provisional unit and full duty home service" is also low as compared to the figure for the cases without murmurs (9 per cent. and 18 per cent. respectively). These reductions in the case of the apical systolic murmurs are chiefly to be accounted for by the permanent discharge of many patients with such murmurs almost as soon as they leave hospital, and without trial, on the ground of the murmur. The actual correction for this cannot be given, but was known, as it affected this table, to be not inconsiderable.

those already given and apply equally to systolic apical and systolic basal murmurs.

Aortic regurgitation.—Aortic disease in soldiers during the last war was attributable to rheumatic fever or chorea in 54 per cent. of cases. This figure is higher than that accepted in civilian practice, because soldiers are young. Syphilitic aortic disease is for the most part a disease of middle age; among those soldiers a history of syphilis, a positive complement fixation test, was found in only 12 per cent.

In diagnosing aortic reflux reliance should first be placed upon the character of the pulse. The water-hammer pulse with throbbing carotids is the most reliable sign of the affection; but if the amount of reflux is small and the arterial phenomena are inconspicuous the early diastolic murmur at the base of the heart is the chief or only sign. This murmur is heard maximally in cases of early disease with greater frequency to the left of the sternum than to the right. It is conducted downwards along the borders of the sternum and towards the heart's maximal impulse.

As a rule the diagnosis is not in doubt or, if in doubt, the symptoms on exercise or signs of enlargement are sufficient to preclude the patient from heavy work. From time to time there is difficulty, when the only physical sign is a faint diastolic murmur appearing to the left of the sternum. In such cases, and where there is a history of rheumatic fever or poor exercise tolerance, aortic disease should be diagnosed. Where help is gained from neither of these sources and the murmur stands alone, the diagnosis of aortic disease should not be made, but the man should obtain the benefit of the doubt and be classed lower from the point of view of fitness than he would be otherwise. Some of these murmurs are exocardial.

Mitral stenosis.—In our armies during the last war this condition was attributable to rheumatic fever or chorea

in at least 65 per cent. of cases. The figure is high as compared to usually accepted figures for similar reasons to those stated under aortic disease. The diagnosis should not be made without the murmur that characterises the condition. An accentuated first heart sound, an accentuated or reduplicated second sound over the base of the heart, are insufficient signs even when a history of rheumatic fever is given. These signs are common in over-acting hearts. Early cases may be detected by the following procedure. In all cases of suspected heart disease the patient should be examined by auscultation while he stands and lies. A large proportion of cases of mitral stenosis discovered in soldiers are very early. The abruptly ending presystolic or full diastolic rumble of mitral stenosis should be diligently sought, and repeated attempts should be made to force it out in all patients in whom a systolic murmur is constantly audible at the apex, in whom the first sound is double, or in whom the first sound is greatly accentuated. Cases in which the murmur is brought out by lying supine or upon the left side, or is audible for a few heart cycles *immediately after* a patient sits and lies quickly six times are very frequent. These tests should not be neglected ; they are to be employed whenever there is the suspicion of stenosis. If this procedure is employed few cases will escape observation and diagnosis becomes far more confident.

Many cases of aortic disease and of mitral stenosis are wonderfully tolerant of physical exercise ; many patients in whom the disease had unquestionably been of long standing saw heavy fighting and were for months or years in and out of the firing line in the last war. It is not on exercise capacity that I judge such men to be unfit for any form of duty. To ask these men to discharge heavy duties, even in the absence of symptoms, would clearly be unfair to them.

Generally, the breakdown when it comes marks the beginning of total incapacity.

Irregular action of the heart.

There are but two common forms of irregularity in the heart's action among soldiers. The one is extrasystole, the other is a respiratory arrhythmia.

Extrasystole.—The extrasystole generally betrays itself by producing intermittence of the pulse; at regular or irregular intervals the pulse beat lapses. This form of intermittence is readily recognised for what it is. The only disorder with which it may be confused is a variety of heart-block, where responses of the ventricle to the auricle are occasionally missed. Among soldiers, intermittence is due to extrasystole in all but rare instances. Diagnosis may be made absolute by attending to the impulse. During the pulse intermission of extrasystole, the heart's rhythm is interrupted by a weak premature beat, which is palpable or audible at the impulse. In heart-block pulse and heart intermit.

Extrasystoles also occur more frequently, grouping the pulse beats in twos and threes. Such grouping of the pulse beats may be due in very rare cases to heart-block. As is the case with simple intermissions, if extrasystole is always held responsible, the error is so small as to be negligible. To distinguish absolutely between the two disorders in instances of group beating the man should be exercised. When the pulse rate is raised by exercise (to 140 or less) the group beating will vanish; while the heart is beating rapidly it should be listened to attentively and the first irregularity should be noted as the rate falls. In an instance of extrasystole, the first irregularity is signalled at the apex by

a premature beat, in heart-block by a pause. There is no necessity to examine these cases instrumentally.

Extrasystoles, whether they produce intermission or group beating, are without significance in prognosis. They are common in patients invalided for supposed heart disorders. Heart-block is a sign of myocardial involvement and is serious.

Respiratory arrhythmia.—This disorder is very frequent and has no more significance than extrasystole. It consists usually of a mild grade of irregularity, which though it may not be apparent at first is related to the respiratory acts. But if the breathing is deepened, the heart rate is noted to increase in inspiration and to slow in expiration. The irregularity is abolished completely when the pulse rate rises or is forced to 120 per minute.

Auricular fibrillation.—This serious disorder of the heart's action indicates myocardial trouble. It is not as frequent in soldiers as in civilians, but when it occurs it is usually accompanied by other and manifest signs of disease. Whether it is so associated or not, it stamps the man as very seriously unfit. It may be diagnosed with considerable certainty by its relations and character.

It is the rule to find this disorder associated with a rapid action of the heart. It may be assumed without undue error to be the only irregularity of the heart accompanying rates of 140 or over. It is the only irregularity which is at all common when the heart beats at 120 or over. If a heart is beating irregularly below the rate of 120 and fibrillation is suspected, the heart's rate should be raised by exercise. The higher the rate attained, the heart remaining irregular, the more certain is the diagnosis.

It is a persistent disorder, being present on all occasions upon which the patient is examined, from hour to hour,

and from day to day, and in all circumstances such as sleep, changing posture, rest or activity.

The pulse is grossly irregular, the irregularity is neither grouped nor related to respiration, however deep the breathing may be.

Auricular flutter.—This serious disorder is very rare before middle life and does not greatly concern military practice. It may be suspected when persistent regular action of the heart at rates of 130 to 150 are found.

Paroxysmal tachycardia.—This disorder is rarer in soldiers than in civilians ; it precludes full duty and in severe cases is to be regarded as a disabling malady. In this condition the heart rate rises abruptly without warning from its usual rate to 140, 160, or even 200 per minute. The patient is usually conscious of the rapid heart action from the moment it comes. The paroxysm is generally repeated. Short paroxysms last a few minutes and may occur daily or several times a day. Long paroxysms last hours or days and are repeated perhaps weekly or monthly. The paroxysm ceases as abruptly as it starts and the patient is conscious of the fact.

To diagnose paroxysmal tachycardia, the patient should be interrogated as to the beginning of the attack and will usually volunteer a clear history of abrupt onset and offset. But in all cases in which the question of discharge from the Army arises, the patient should be seen in an attack. When witnessed, the nature of the tachycardia is easily determined. The rate of beating is uninfluenced by posture, by rest, or by exercise. This test is decisive, but the rate should be taken at the heart and not at the pulse. In some cases the paroxysms, if long continued, are accompanied by venous engorgement ; not infrequently, though wrongly, they are

then referred to heart strain. Exertion predisposes to attacks but is not the cause of the malady.

Pulsus alternans.—This disorder is not found in young men with sufficient frequency to render it of value in military practice. It is essentially a phenomenon associated with such conditions as coronary thrombosis, high blood pressure, or angina of effort.

Failure with congestion.

Few cases with general congestion of the venous system will fail to be detected, for they are always breathless on slight exertion, are often cyanosed, and all show clear signs in the veins of the neck when recumbent. In an easy standing posture, the veins of the neck are normally collapsed. Place the subject on his back with the head on two pillows and manifest venous pulsation is normally to be seen at the root of the neck in young men. When there is congestion the veins are swollen above the horizontal level of the clavicle and sometimes to the angle of the jaw, in the same posture; they may pulsate high in the neck or may be too turgid to move at all. In congestion, but not in health, pulsation is frequent in the veins at the root of the neck in the erect posture. It is important to distinguish arterial from venous pulsation, the former is palpable, is more prominent in the erect posture, occurs more in the carotid triangle, and is a simple thrust and not a complex fluctuation.

When the veins are congested in failure, the liver is enlarged and there is often ascites. The signs are given briefly, for very few such cases will regard themselves as nearly fit for service, and no case can possibly be passed as fit if the reactions to exercise are tested as a routine.

Hypertension.

Essential hypertension rarely occurs in men before 45, or in women before 40 ; its chief incidence is from 50 years onwards. There are no characteristic symptoms, but headache, irritability, and breathlessness are common and minor cerebral attacks may occur.

The experienced will recognise a high tension pulse by the feel of it, but cases will not usually be discovered unless blood pressures are taken in likely subjects. Once diagnosed, the examination should proceed to tests of renal function. Uncomplicated essential hypertension is compatible with many years of relatively healthy and active life, though not with soldiering. Gallop rhythm, much cardiac enlargement, nocturnal breathlessness, renal insufficiency, and signs of congestion, are all unfavourable and in increasing degree in this order.

Single readings of systolic blood pressure up to 180 mm. Hg, in soldiers who are out of bed, are not of much value in diagnosing essential hypertension. Readings of 230 and over are much more significant. Readings as high as 180 are not infrequent in "effort syndrome" cases ; effort or excitement carries readings to high points in these. Essential hypertension should not be diagnosed unless successive readings such as 180 to 200 have been recorded in the subject lying at ease and completely rested ; preferably it should not be made until such readings have been taken with the subject in bed.

Blood pressure in the arm is high in the rare congenital condition, coarctation of the aorta ; these cases present no femoral pulse, or a small delayed one, palpable anastomoses around the scapula, and ribs visibly eroded in the X-ray picture.

Aortic enlargement.

Syphilitic aortitis, which is the cause of aortic dilatation and aneurysm, is a disease of middle life; it is very rare before the age of 35. Aneurysm should rarely be diagnosed before 40. The early diagnosis of aortic enlargement (dilatation) will generally depend upon the detection of dulness in the 2nd space near the sternum; it should be sought in all cases of breathlessness or cardiac enlargement in middle aged soldiers. Enlargement of the aorta is often associated with aortic regurgitation; but the latter is in itself enough to proclaim unfitness for active work. A ringing second sound at the aortic cartilage is not infrequent. X-ray examination will give the final verdict.

Angina pectoris.

Grave angina occurs in soldiers in three forms.

Angina of effort.—This, the commonest form is rare before middle years and is essentially a malady of the elderly. It consists of continuous pain or a feeling of tension behind the upper part of the sternum, coming on during exercise, increasing in intensity if exercise continues, but passing away if the man rests. When intense it may radiate into the left arm, the neck, or the right arm. The pain is more apt to occur when exercising after meals or during cold weather. It shows considerable consistency in its relation to effort; it is relieved by nitrites. Signs of cardiac enlargement may be found, but infrequently unless blood pressure is high. The condition is incompatible with active work.

Angina at rest.—This form occurs from time to time in young soldiers, suffering from free aortic regurgitation and enlargement of the heart. The attacks of pain are associated

with palpitation, flushing, and rise of blood pressure. They occur usually during the early hours of morning. Nitrites relieve this pain.

Coronary thrombosis.—A rare malady before 40 years, its onset is usually marked by a single attack of anginal pain lasting for hours or even days, associated often with prostration, pallor, a little cyanosis, breathlessness. After a day or two low fever appears, accompanied by leucocytosis, often with cough and sticky white sputum, sometimes with embolic phenomena, or friction over the precordium. Nitrites fail to relieve the pain.

Differentiation.—Confusion may happen between angina of effort and the precordial pains of “effort syndrome,” for the latter are usually provoked by exercise. The chief points of differentiation are as follows :—Angina of effort is rare before 40 years, and uncommon before 45 years. The pain in effort syndrome is usually precordial and not retrosternal ; it may be described as aching or as stabbing ; it is not consistently related to exercise, it often comes after, rather than during, exercise and often persists for an hour, a day, or more ; it is not unusual during resting hours ; it is usually associated with high pulse rate, precordial tenderness, and often with neuroses. Nitrites do not relieve the pain.

Myocardial disease.

Myocardial disease should not be diagnosed as such, neither should fatty or fibroid disease of the heart. It is sounder to build a prognosis on clearly recognisable phenomena such as cardiac enlargement, signs of failure, evidences of angina, auricular fibrillation. These maladies are often associated with an unhealthy myocardium, but they themselves disqualify a man from continuing active work. Faith

should not be placed in modifications of the heart sounds. Serious myocardial disease is incompatible with a good exercise tolerance.

Men who have developed breathlessness after 45 years, and who present no detectable cause for it, should be suspected to be suffering from the early symptoms of cardiac failure.

Subacute bacterial endocarditis.

This disease occurred sporadically among our soldiers during the last war, and especially after the influenza epidemic. In nearly all cases it is implanted on valvular disease (aortic regurgitation or mitral stenosis). It is marked usually by pallor, clubbing of the fingers, and palpability of the spleen. The two first named are the chief guides to its diagnosis in walking subjects. Fever is of low grade and there are afebrile periods; petechiæ are frequent on the skin of arms, neck, or trunk. Painful purple spots recurring on the finger tips are almost diagnostic; embolism of named arteries occurs from time to time. The disease is fatal. Its chief importance to military practice is the frequency of its insidious onset, and its long duration (months or even years); I have known a case in which a man suffered from it for months in a front line trench.

VII.—EXAMINATION OF RECRUITS.

Introductory.

The faulty examination of recruits in the last war is clearly illustrated by the table, which shows that nearly half the patients invalided for “effort syndrome” or heart disease, developed their symptoms before joining the forces, and that more than half developed them before their training was complete. There is not the slightest doubt that adequate examination would have eliminated most of these men,

	Onset of symptoms.			Invalided on training.	Invalided on active service.
	Before joining.	On training.	On active service.		
“Effort syndrome” (558 cases)	242 (43%)	65 (12%)	251 (45%)	125 (22%)	433 (78%)
“Heart disease” (101 cases)	37 (36%)	30 (30%)	34 (34%)	32 (32%)	69 (68%)

would have kept them in useful employment, would have spared them much suffering, would have saved hospital space and large funds of the Ministry of Pensions. It has been pointed out earlier that such cases were 6 or 7 months in training, 5 months in hospital, and gave in return 2·2 to 2·8 months of full and $\frac{1}{2}$ to 2 months of light duty. The

pensions bill for "cardiovascular" cases through the years has amounted to many millions of pounds. Half this wastage was unnecessary. The recruiting boards were at fault, not only because of the rush of eager volunteers, but because those who sat upon the boards failed to realise that the stethoscope is a poor instrument with which to separate fit from unfit people. It will cast out a proportion of the unfit; it can never prove soundness of health or even of heart or lungs.

The conclusion, that a man's capacity for work is ascertained most certainly by putting him to work and watching his reaction, was accepted tardily. It was seemingly too simple to hold attention. During the years of the last war I said that had the examination of recruits been done by instructors of physical training on a parade ground, through and through it would have been more efficient than it was. That this was true of cases afterwards classed by the Ministry of Pensions as cardiovascular and pulmonary, I have no doubt whatsoever. During the last war, and especially during the last two years of it, methods improved, exercise tests being more often used; but they were not being used enough, and the same is true of to-day. Unsuitable recruits have recently been taken by the services in numbers, because tolerance tests have not been applied properly to them. The examination of recruits is sounder in 1940 than it was in 1915; but the old fault is still there. In some classes of recruits, those drawn from heavy trades, exercise tests may be redundant; but upon recruits drawn from sedentary or light work, such tests as will render each man obviously breathless should always be used before grading him for service. The only way of judging a man fit for heavy work is to give him heavy work to do; it cannot be done by looking at him resting and stripped. There are three chief reasons

why full exercise tests are neglected. In the first place, their surpassing value is not appreciated. In the second, they are believed to use up too much time. Thirdly, they are mistakenly regarded as risky. On the first point enough has been said.

The amount of time that can be spent profitably in thoroughly testing a recruit's exercise capacity, can be settled only by considering how the unfit can be eliminated and the cost both to man and nation of failing in this. There are so many possible tests. Appropriate drills, exercises, or quick marches might with ease be arranged under suitable non-commissioned officers, testing the men many at a time. These exercises at all events would give complete confidence that most of the men tested were fit for heavy tasks ; they would actually do more, they would select from the crowd men having obviously low exercise tolerance and those to whom it would be desirable for medical advisers to give more attention. I think that a method such as that suggested is desirable ; emphatically I would say that such a method, or an exercise done before the medical examiner and strenuous enough to bring each recruit to obvious breathlessness, before he is passed, is essential in sound recruiting.

To those who fear the tests may injure some recruits, there are two things to say. First, that there is almost no risk, with tests properly arranged. Remember the Colchester record, where 500 men were drilled daily, many of them strenuously, on a parade ground to which was sent also any case of mitral stenosis or of aortic regurgitation that was not distressed by walking up and down stairs ; there were no accidents ; there were none because no man was brought to a severe test before he had shown himself capable of less severe ones. To impose a first easy test and then, if it is passed, a test producing breathlessness has been my rule throughout

the years of peace, and cases of heart disease of all kinds have submitted to one or both without untoward incident. When a heart case complains of frequent pain or breathlessness, he is regularly submitting himself to tests that produce those symptoms; may not a medical man see such reactions? Secondly, it is to be said that if there is a patient who would be distressed by such tests as are here advocated, it is far better from every point of view that such distress should occur at the medical board, and should be seen and checked as it develops, than that the distress should reach its full development, without chance of escape or relief, under those conditions of service that the man is deliberately recruited to meet.

The preliminary examination.

This is specially written for the service recruiting boards; but it applies in judging a man's fitness for heavy work of any kind. The same examination will help to gauge a man's disability for insurance or pension purposes. While intended especially to apply to undefined ill-health and to cardiac cases, the examination can be applied to, or easily combined with the testing of, pulmonary cases.

The recruit stands at ease and stripped in front of the examiner, who notes in health the presence or absence of certain signs in quick and orderly succession. Looking at the man he sees his mouth closed, no pallor or blueness of the face, no distension of veins at the root of the neck, little or no sign of pulsation in the neck; as his glance falls to the chest he sees no bulging of precordium, and notes the slow and even rise and fall of respiration. These points are taken in almost at a glance, and unfailingly when the habit has been for a short time cultivated. The examiner places his whole right hand flat on the precordium, and should note the approximate rate of the heart beat, the regular action, the

absence of excessive or extensive throb, or thrill. He defines the heart's chief impulse, and should find it, if it is to be found at all, no further out than the nipple line. He proceeds to percuss with a few quick strokes the left border of the heart's dulness and should find it at or inside the nipple line. The second interspaces should be percussed in men over 40 years. He listens at the maximal impulse and notes the clear sounds of the heart while the patient holds his breath in expiration. He listens at the second right cartilage and in the second and third left spaces and particularly heeds the periods of early diastole, noting clear heart sounds without trace of diastolic murmur while the breath is again held in expiration. He asks the man to lie down, preferable with head towards the light and slightly raised. He views the neck again and notes a leisurely filling and more or less pulsation of the veins just above the clavicle ; he glances again at the precordium and sees no excess of pulsation, feels it again, and listening to the heart sounds, hears them clear and unbroken. Such an examination takes but a few moments. If it is passed and no history of anginal pain, fainting, or paroxysmal tachycardia has been volunteered, the man is given exercise tests, to be described presently. If the examination is not passed, he is not necessarily unfit but should be searched further according to what has been found already.

For the preliminary examination certain signs may be found that call for brief comment.

Pallor of the face.—If the mucous membranes are of good colour, pallor may be passed over. If there is anæmia, with or without infection, further special enquiry may be desirable ; but the recruit is unlikely to pass the exercise tests.

Blueness of the cheeks or ears may be the result of coldness. Cyanosis of the lips, resulting from cardiac failure, is always accompanied by breathlessness at rest and by engorgement of the veins.

Excessive pulsation in the neck.—This may be arterial or venous (page 77). Excessive arterial pulsation should lead to close search for aortic regurgitation or high blood pressure ; it occurs also in “effort syndrome.”

Throb of the heart.—An excessive throb or diffuse impulse requires the careful exclusion of enlargement of the heart (page 63).

Disordered heart action.—Irregularity if present must be identified ; cases of auricular fibrillation are unfit for any grade of service. The heart may beat with unusual slowness. A rate of 40 or lower is almost always a sign of unsoundness. Otherwise healthy men with such rates, or rates slightly higher may be referred for special examination. Young men at ease often present rates of 50 to 60. A single count of rapid action has little value, it is often due to nervousness. In pathological tachycardias the rate while fast does not change with posture or exercise. In the case of physiological tachycardia, the rate does change ; if there is no apparent cause for the excessive rate, the man may be classed purely on exercise tolerance, or referred for special examination.

Abnormal heart sounds.—If on listening at the heart's maximal impulse the first sound is abrupt and loud, if it is reduplicated, if there is an indefinite muffled sound preceding the first sound, or if a systolic murmur is present, the stethoscope should be placed on the impulse as soon as the man has turned onto his left side ; sometimes this will reveal the murmur of mitral stenosis (*see* page 73). If this is not found the unusual sounds may be neglected.

A systolic murmur at the base of the heart, especially if harsh, suggests further search and nothing more. Occurring to the right of sternum it may be associated with thrill and slow rising pulse; only in these circumstances is aortic stenosis to be thought of. Occurring to the left of the sternum it may be associated with thrill, in which circumstance only does it suggest congenital heart disease.

Thus a systolic murmur, though never enough to reject a recruit, should lead to closer scrutiny of the heart for more important signs.

Basal dulness.—Dulness in the second interspaces and behind the sternum in men over 40 should arouse suspicion of aortic enlargement.

Hypertension.—It would be wise to take the blood pressure in all men over 45 years and in women over 40 years.

Reliable signs of heart disease.—In recruits, the chief signs indicating serious disease are :—Breathlessness at rest. Over-distension of the veins of the neck. Definite signs of cardiac enlargement. Irregular action with fast heart rate. An early diastolic murmur to right or left of the sternum. A diastolic rumble at the impulse. A basal or apical thrill. Blood pressure of 180 or over at rest.

Test exercises.

If there are no clear signs of disease, judgment should rest purely on the observed response to exercise. A first and important duty of members of recruiting, discharging, and pensioning boards is to familiarise themselves with the reactions of the body to test exercises in health and disease.

When a recruit is found to have heart or lung disease in the preliminary examination, exercise tests are superfluous. The tests are only for those in whom no signs themselves warranting the rejection of the recruit have been seen.

If a man is breathless while standing for examination, exercise tests are obviously redundant; the answer which these would give is already clear.

The preliminary exercise is quite safe and should be used in all other cases.

Preliminary test.—The recruit should be asked to

- (a) walk briskly up 40 stairs, taking one step at a time.
- (b) hop 20 times easily on each foot, raising the shoulders 6 inches at each hop.
- (c) step up onto a 15 to 18 inch chair 20 times (in 60 sec.), coming upright each time. The subject may use the back of the chair to steady himself.

The best of these tests is the stair test, because it is the most customary form of exercise; but the most convenient should be used and one only of the three.

A subject in good health but sedentary occupation will show in any of these tests little respiratory reaction, the pulse will rise no more than 20 or 25 beats per minute and will resume its original rate within $1\frac{1}{2}$ minutes. The respiratory response is more important than the pulse; feel the pulse while watching the breathing at the end of the test; questions should be answered without any interruption by breathing. Any man whose breathing is obviously disturbed by this test, or whose pulse rises by more than 30 beats and falls slowly has a *poor* exercise tolerance and should not be passed into Grades I, II, or III, without re-examination, and then usually only into Grade III or IV. Experience has shown that the response may be increased by infections like the common cold. Re-examination may show an improved reaction; if it does not, few such men can be regarded as fit for more than sedentary work.

The preliminary test will fail to sift out many recruits with serious cardiac mischief or "effort syndrome." When passed, it must be followed therefore by a more strenuous test.

Final test.—This test need only be employed when the preliminary test has been passed; it is then always quite safe to use it. Men, who declare that their wind is good, may be submitted to it without preliminary. Its *object is to produce breathlessness*, and the gauge of tolerance is the amount of exercise taken. A weight of 20 lbs. (women 10 lbs.) is raised from an inch above the floor to the full extent of the arms above the head, the arms being raised in an easy smooth movement at the rate of one lift in 2 seconds.

A healthy young man of sedentary habit can repeat this lift 30 to 60 times, but at the end he will be so breathless that he will wish to stop and will be seen to have laboured breathing. An athlete in training will continue much longer without complaint.

Unhealthy men (effort syndrome, cardiac, and respiratory cases) with deficient respiratory reserve, will become clearly distressed when less than 20 lifts have been completed; the exercise can be stopped at any stage if, during the exercise, the mouth opens in inspiration and there are clear signs of respiratory embarrassment; thus the man should be watched so that if it is thought undesirable a point of conspicuous breathlessness is not reached. No man should be declared fit for Grades I or II who cannot make 20 lifts, those who cannot make 30 lifts should be recommended for graduated training; most men who make upwards of 30 lifts are fit for Grade I.

Occasional cases of quite uncomplicated mitral stenosis and of early aortic regurgitation of slight but definite enlargement of the heart, will pass these tests satisfactorily

if they are tried upon them. Such men if called upon would give a great deal of useful service, though it is wise not to contemplate recruiting them except in the gravest emergency, or purely for their exceptional merit in sedentary work. No sufferers from usual forms of heart disease other than these will pass both exercise tests satisfactorily.

If there is any doubt in the preliminary examination about the presence of a significant murmur, or about the size of the heart, the recruit should be graded purely on exercise tolerance, but a slightly higher tolerance than would otherwise be the case should be demanded of him.

VIII.—MEDICAL REPORTS ON DISCHARGED SOLDIERS.*

To answer these forms is one of the most responsible tasks of the medical officer in charge of the case and of those who sit upon discharging and pensioning boards. Upon the correctness of the return depends the fair treatment of the discharged soldier and the expense involved by the State. Hasty returns on the Service forms interfere with the smooth working and efficiency of pension boards; in the future they will bring hardship to individual men, and unnecessary calls upon the public purse. The State can compensate the men who have served it, but the amount that can be given has a limit and it is a duty to see that it is justly distributed; assessments should be as uniform as possible.

I propose here to discuss some of the more important points that should be weighed by medical officers before they fill these forms, confining myself to "effort syndrome" and heart cases. It will be convenient to do so in relation to questions asked on Ministry of Pensions Board forms and those used by the Services for the discharge of officers and men medically unfit.

* Submitted before publication to the Ministry of Pensions, and suggestions of that Ministry embodied in it.

1. *Date and place of disability.*

In giving the date of origin of "effort syndrome" the time at which the first symptoms were experienced should be entered. In a high percentage of the cases this answer will be "in civil life" with or without an actual date. The time of onset should be ascertained during the patient's stay in hospital and not after his discharge. A long history, as the men well know, makes for boarding as unfit; but the same history decreases the awards of the pension board. A dilemma of this kind stimulates a truthful answer. In cases of *mitral stenosis* the onset of symptoms may be used, provided that the symptoms started in civil life. If the symptoms arose during the period of service the answer is more difficult. It may be taken that an early mitral stenosis is of at least three years standing, and a fully developed stenosis is of at least five years standing. The condition develops slowly. Mitral stenosis found within 3 years of entering the Army cannot be ascribed to service. It may often be dated to rheumatic fever or chorea. The medical officer is on his safest ground when in early cases a history of rheumatic fever antedates the board by three or five years, and when in fully developed cases the rheumatic fever antedates the board by some five or ten years. *In aortic disease* the estimated date of origin, when the symptoms start after enlistment, should be given as the date of rheumatic fever in the history. But if, as so often happens, there is no such history of infection it should be borne in mind that rheumatic disease is essentially one of childhood and adolescence and that primary rheumatic carditis occurring after the age of 20 is very rare. If, however, symptoms are recent in origin, the date of their onset should be recorded. As opposed to mitral stenosis, aortic defects often develop

quickly in rheumatic disease. A positive complement fixation test in an aortic case usually indicates old-standing disease of the aorta, usually of not less than five years standing, if the aortic disease is judged to be syphilitic. If there is much cardiac enlargement, it may be dated to the onset of symptoms or to previous rheumatic fever; *aneurysm* should be dated as in aortic disease of syphilitic origin. *High blood pressure* comes insidiously over a period of several or many years.

2. *The essential facts in the history of the disability, etc..*

These are usually stated with unfortunate brevity. The statement should include a note on the man's capacity for exercise or work in school life or at any other relevant date prior to enlistment; dates of relevant infections; length and tolerance of training and its type; length and character of duty performed; a brief history of symptoms with a note on any event to which the symptoms are dated.

3. (a) *The causation of the disability.* (b) *If it originated during military service, state if any specific military conditions or circumstances determined its origin.*

The answers should conform with those previously given. In "effort syndrome" the answer under (a) will be "constitutional," "service conditions," or "infection"; occasionally it will be "gas poisoning." In heart cases the answer under (a) will usually be "rheumatic fever," or occasionally "syphilis." Under (b) the reply will usually be "did not so originate" or "did so originate, but no specific military condition," etc..

4. *Evidence that the disability is due to serious negligence or misconduct on the part of the man, etc..*

The only entry that can occur, except quite rarely, is a history or sign of venereal disease. In syphilitic disease of the heart, the infection will have occurred many years before the heart disease declares itself.

5. *Description of the present condition and its effect on function.*

The observed symptoms, the size of the heart, the presence of thrills or murmurs, the presence of a grave irregularity, should be noted, and in all instances a note made on the observed tolerance of exercise. Signs of failure of the heart should also be noted if present.

In "effort syndrome" the effect on function should almost always be given as "slight." The disability table (page 101) will aid the selection of cases to be classed as "moderately" or "severely" disabled.

6. *Entitlement. In respect of each disability the medical board is required to express their view as to whether :—*

- (i) it is directly attributable to service, or
- (ii) although not directly attributable thereto, it has been aggravated thereby to a material extent and remains so aggravated, or
- (iii) it is not connected with present war service.

All cases of effort syndrome arising in civil life can obviously be no more than aggravated by service conditions, and in determining whether material aggravation by service has occurred regard must be had to the nature and duration of the man's service. Similarly, most cases of heart disease are of pre-war origin and must be considered on similar lines.

In cases of organic disease, which have been materially aggravated, such aggravation will usually still persist at the time of boarding and for a material period afterwards.

7. *Opinion on the disability being in a final stationary condition.*

The answer in "effort syndrome" and heart cases is always in the negative.

8. *Probable minimum duration of the present degree of disablement.*

In structural heart disease the disability will be permanent, but in certain cases an improvement in cardiac function may be looked for and, in such, an estimate of the average degree of disablement over a period, usually of 1 year, would be appropriate.

In "effort syndrome" cases it should be "six," "nine" or "twelve" months, according to length of past history and severity. One of the longer periods should usually be entered. All cases in which duration of the malady is considered temporary or uncertain should come up for re-examination.

9. *The degree of disablement as compared with a normal healthy person of the same age independent of hospital or other treatment.*

Disablement means "the loss of physical or mental capacity, or the physical or mental injury or damage, suffered by reason of disability or disabilities attributable to war service." The basis of the estimate is to be "a comparison of his condition as disabled with the condition of a normal healthy person of the same age and sex, without

taking into account the earning capacity in his disabled condition in his own or other occupation.”

The information required is in respect of *total* disability, including the disability on joining the Army, and is to be stated in percentage terms. In answering this question there are two considerations. The first is an estimate of the man's actual physical capacity for work without distress ; the second is the advisability of his engaging in such work ; thus a man may have the strength to accomplish a task, but his condition may be such that the work endangers his health or his life.

“*Effort syndrome.*”—The exercise tolerance of the men in the whole group is very variable. On leaving a home hospital it is gauged as normal or little reduced in 20 per cent. ; it is reduced to the extent that there is appreciable difficulty in taking five-mile route marches and in doing stiff thirty-minute exercises in the next 30 per cent. ; it is so reduced as to render the men incapable of such marches and exercises in the next 30 per cent. ; it is reduced so that anything but very light physical work is precluded and so that there is discomfort in walking one to two miles daily in the last 20 per cent. in the average.

The capacity for work as judged by return to occupations forms a serviceable check to the observed tolerance in hospital. It has been found that very few cases are unoccupied nine months after discharge ; and these men are then doing full days of work. Many return to their former occupations, others return to lighter work.

Men originally in heavy employments pass in the main into lighter employments ; so do those originally on moderately heavy work, though to a lesser extent. Among the men originally employed on light or sedentary work the

Numbers of men engaged in work of different grades. (Year 1915).

<i>Work before serving.</i>				<i>Work after serving.</i>			
27	heavy	...	...	...	...	...	...
						{	7 heavy 8 moderate 10 light or sedentary 2 none
27	moderate	...	...	...	...	{	1 heavy 11 moderate 13 light or sedentary 2 none
43	light or sedentary	...	...	...	...	{	1 moderate 38 light or sedentary 4 none.
—						—	
97						97	

capacity for work is but little changed by their term of Army service. It is noteworthy that a man from whom the Army can obtain only an hour's work will work seven a day the moment he is subject to the wage-earning stimulus.

Degree of disablement is to be judged in "effort syndrome" cases on capacity alone. The employments which the men take up do them no injury; on the contrary, they are beneficial, as evidenced by the improvement in the group as a whole. Inquiries have clearly elicited that there is improvement, both in 9 months and in 5 year after-histories (see page 57).

The disability in "effort syndrome" cases with fair exercise tolerance may be placed justly at 20 per cent. or less, and in those with poor exercise tolerance at 30 to 40 per cent.. Exceptionally it may be placed as high as 50 per cent. in cases where development and tolerance are poor. In the average, the assessment of the disability at the first re-examination of the pensioners should decrease by 10 per cent. if this re-examination occurs at the end of nine months.

Mitral stenosis.—In early and uncomplicated cases of mitral stenosis, stenosis of such degree that the characteristic

murmur is present on occasion only, or only on lying on the side, the exercise tolerance is often quite normal ; many men with this valvular defect have spent months on front line work, have been in heavy fighting, and have been little the worse for it. In early cases there is often no reduction of physical capacity for work, but it is inadvisable that they should be engaged in heavy work despite good exercise tolerance. Where there is a developed stenosis, as indicated by a diastolic murmur or thrill constant in all postures, or where early stenosis is combined with poor exercise tolerance, the disability should be assessed highly (the details of assessment are shown in the table). The other chief factors of significance in gauging the extent of disability are enlargement of the heart, venous congestion, and untreated fibrillation of the auricles. The presence of any of these three should place the assessment very high. If two or more are found in combination the disability is almost total.

Aortic disease.—Much of the same considerations apply in aortic disease as in mitral stenosis. But aortic disease is to be regarded as the more serious lesion, and I assess it 10 per cent. higher throughout. In some patients with aortic disease exercise tolerance is perfect ; many soldiers have fought in the front line with this lesion and without mishap ; some cases of aortic disease live to a good age. But these are cases in which the lesion, as judged by the state of the pulse, is slight and in which there is no material cardiac enlargement or other complicating factor. The presence of a poor exercise tolerance is, as a rule, a clear indication of the seriousness of the lesion ; the presence of much cardiac enlargement, of congestion, or of angina pectoris is ominous. Aortic disease is assessed in the accompanying table as “slight” or “developed.” Slight aortic disease

exhibits an early diastolic murmur at the base without any material change in the pulse. Developed aortic disease displays collapsing pulse, or aortic regurgitation with stenosis.

Enlargement of the heart.—Soldiers discharged from the Army may exhibit cardiac enlargement in the absence of a valve lesion or other obvious cause to account for it. When such enlargement is more than slight, or when it is associated with poor exercise tolerance, the condition forms a serious disability. If fibrillation is present or if venous congestion is added then the disability is very similar to that found in similar cases in which mitral stenosis is also present.

Essential hypertension.—The condition may last 20 or 30 years. Subjects with the uncomplicated condition are capable of a full day's light work. Exercise tolerance is rarely more than poor. When renal insufficiency or cardiac failure appears the condition is one of gravity.

Venous congestion.—Cases that once exhibit congestion are in general unfit for anything but the lightest occupation ; in most cases the presence of congestion demands rest in bed. It indicates a very high grade of disability.

Aortic aneurysm or grave angina pectoris naturally involves very high grades of disability.

Fibrillation of the auricles.—The duration of life is rarely more than ten years. Fibrillation is rarely uncomplicated. By itself it should be the ground of assessing the disability highly. The capacity for work may be increased by appropriate treatment.

Auricular flutter.—This condition is very rare in soldiers. It may be assessed as is fibrillation.

Table of percentage disabilities.

<i>Effort syndrome</i> (with or without systolic apical murmur)						
With fair exercise tolerance...	...	...	...	...	...	20% or less.
With poor exercise tolerance	...	...	...	...	...	30-40%
<i>Mitral stenosis</i>						
Early with good exercise tolerance	...	...	...	...	...	30%
Early with poor exercise tolerance...	...	...	...	...	...	50%
Developed with fair exercise tolerance	...	...	...	...	...	50%
Developed with poor exercise tolerance	...	...	...	...	...	60%
Developed with enlargement	...	...	...	...	...	70%
Developed with enlargement and venous congestion	...	...	...	...	...	80%
Developed with fibrillation (untreated) but no enlargement	...	...	...	...	...	70%
Developed with enlargement and dropsy	...	...	...	...	...	100%
<i>Aortic disease</i>						
Slight with good exercise tolerance	...	...	...	...	...	40%
Slight with poor exercise tolerance	...	...	...	...	...	60%
Developed with much enlargement	...	...	...	...	...	80%
Developed with enlargement and congestion or angina	...	...	...	...	...	100%
Developed with enlargement and renal disease	...	...	...	...	...
<i>Enlargement</i>						
Slight but definite with good exercise tolerance	...	...	...	...	...	20%
Slight but definite with poor exercise tolerance	...	...	...	...	...	40%
Moderate with poor exercise tolerance	...	...	...	...	...	50%
Great with poor exercise tolerance...	...	...	...	...	...	70%
for untreated fibrillation or venous congestion	...	...	...	...	...	add 30%
<i>Essential hypertension</i> (according to size of heart and state of circulation)						
...	...	...	...	...	...	30-100%
<i>Venous congestion</i> (according to degree)						
...	...	...	...	...	...	70-100%
<i>Aortic aneurysm</i>						
...	...	...	...	...	...	70-100%
<i>Angina pectoris</i>						
...	...	...	...	...	...	50-100%
<i>Fibrillation of auricles</i> (<i>persistent flutter</i>)						
Without signs of cardiac failure	...	...	...	...	...	40%
With fair exercise tolerance and untreated	...	...	...	...	...
<i>Paroxysmal tachycardia</i>						
Mild and infrequent attacks	...	...	...	...	...	less than 20%
Severe and infrequent attacks	...	...	...	...	...	30%
Severe and frequent attacks	...	...	...	...	...	50%

Paroxysmal tachycardia.—When the attacks are mild and infrequent and the condition is uncomplicated (the usual picture) the disability is slight. More severe attacks debar from heavy work, even though the attacks are infrequent, for such work will often provoke further attacks. Severe and frequent attacks prohibit heavy and moderately heavy work. If complicated by other cardiac defects, paroxysmal tachycardia may be assessed on the same lines as fibrillation.

Mitral regurgitation.—Systolic murmurs have been omitted from the table of disabilities. The assessment of the disability when a systolic murmur is present should be based exclusively on associated factors, such as exercise tolerance, enlargement of the heart, fibrillation, aortic disease, etc.. Where exercise tolerance is normal no assessment is required. Cases uncomplicated by enlargement, but showing only fair exercise tolerance, fall in the “effort syndrome” group and start with an assessed disability of 20 per cent. or less; if slight enlargement is present, the assessment is from 20-40 per cent. (see “enlargement” group in the table) according to the exercise tolerance. Consideration of the murmur itself is not only unnecessary in assessing, but leads to difficulty in fair assessment.

10. *The degree of disablement which existed at the time of entry.*

The answer to this question should be expressed as a percentage. The chief points for consideration in “effort syndrome” cases that have arisen before enlistment are (a) an estimate of exercise tolerance immediately before enlistment; (b) the effects of infection, gassing, etc., after joining, or any other event happening on active service known notably to aggravate.

In cases of heart disease arising before enlistment, aggravation may always be considered to have occurred when any material service of a strenuous kind has been given, or there has been any incident resulting from service calculated to have an adverse effect on the heart. In general, in a case of heart disease, the lowest percentage disability given for the diagnostic group to which the man belongs in the disability table may be taken as the *maximal* (though not necessarily the minimal figure) for the disability at *enlistment*. This is recommended because although a lesion, such as early and uncomplicated mitral stenosis or aortic reflux, may have passed unnoticed by the recruiting board, such lesions, in the presence of complications could scarcely have remained undiscovered. Thus, the complications may in general be viewed as "aggravation." Thus in a case of mitral stenosis arising in civil life the disability on enlistment should be placed no higher than 30 per cent..

